

6/0

RCRA Facility Investigation Work Plan

for

Naval Weapons Industrial Reserve Plant

Calverton, New York



**Northern Division
Naval Facilities Engineering Command**
Contract Number N62472-90-D-1298
Contract Task Order 0090

July 1993



Halliburton NUS
CORPORATION

**RCRA FACILITY INVESTIGATION
WORK PLAN
FOR THE NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

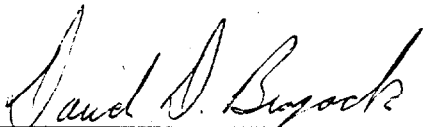
**Submitted to:
Northern Division
Environmental Branch, Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090**

**Submitted by:
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**Contract Number N62472-90-D-1298
Contract Task Order 0090**


July 1993

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Plan E	-	Community Relations Plan

**RCRA Facility Investigation
Data Collection Quality
Assurance Project Plan**

for

**Naval Weapons
Industrial Reserve Plant**
Calverton, New York



**Northern Division
Naval Facilities Engineering Command**

Contract Number N62472-90-D-1298

Contract Task Order 0090

July 1993

**RCRA FACILITY INVESTIGATION
DATA COLLECTION QUALITY ASSURANCE PROJECT PLAN
FOR
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

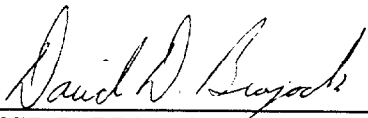
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**CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0090**

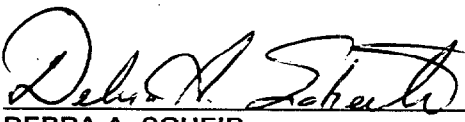
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1.0 PROJECT DESCRIPTION

1.1 AUTHORIZATION

As requested by the U.S. Navy, Halliburton NUS Environmental Corporation, a Division of Brown & Root, Inc. (Halliburton NUS) has prepared this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for the Naval Weapons Industrial Reserve Plant (NWIRP), located in Calverton, New York. This RFI Work Plan is being prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62472-90-D-1298, Contract Task Order (CTO) 0090. This Work Plan was prepared in accordance with the New York State RCRA Hazardous Waste Permit for the facility (NYSDEC 1-4730-00013/00001-0), dated March 25, 1992. The permit references the New York State Department of Environmental Conservation (NYSDEC) RCRA Quality Assurance Project Plan (QAPP) Guidance document (NYSDEC, 1991) for direction in preparing plans. As a result, this document has been prepared in accordance with the NYSDEC QAPP format.

This work plan is also intended to comply with the requirements of the United States Environmental Protection Agency (EPA) facility permit (EPA ID Number NYD003995198), dated May 11, 1992. The EPA permit requests the performance of a RCRA Facility Investigation. The requirements of both permits appear to be the same, although terminology and format vary.

The Calverton NWIRP is located in Suffolk County on Long Island, New York, see Figures 1-1 and 1-2. The primary mission at the facility is to assemble and test aircraft. The NWIRP is a Government-Owned Contractor Operated (GOCO) facility operated by Grumman Corporation.

1.2 PURPOSE

The objective of this study is to obtain environmental information at each site in order to:

- Delineate the nature and extent of contamination at each site.
- Evaluate potential risks to human health and/or the environment posed by the contaminants found at each site.
- Collect data necessary to conduct a Corrective Measure Study.

A-1-2

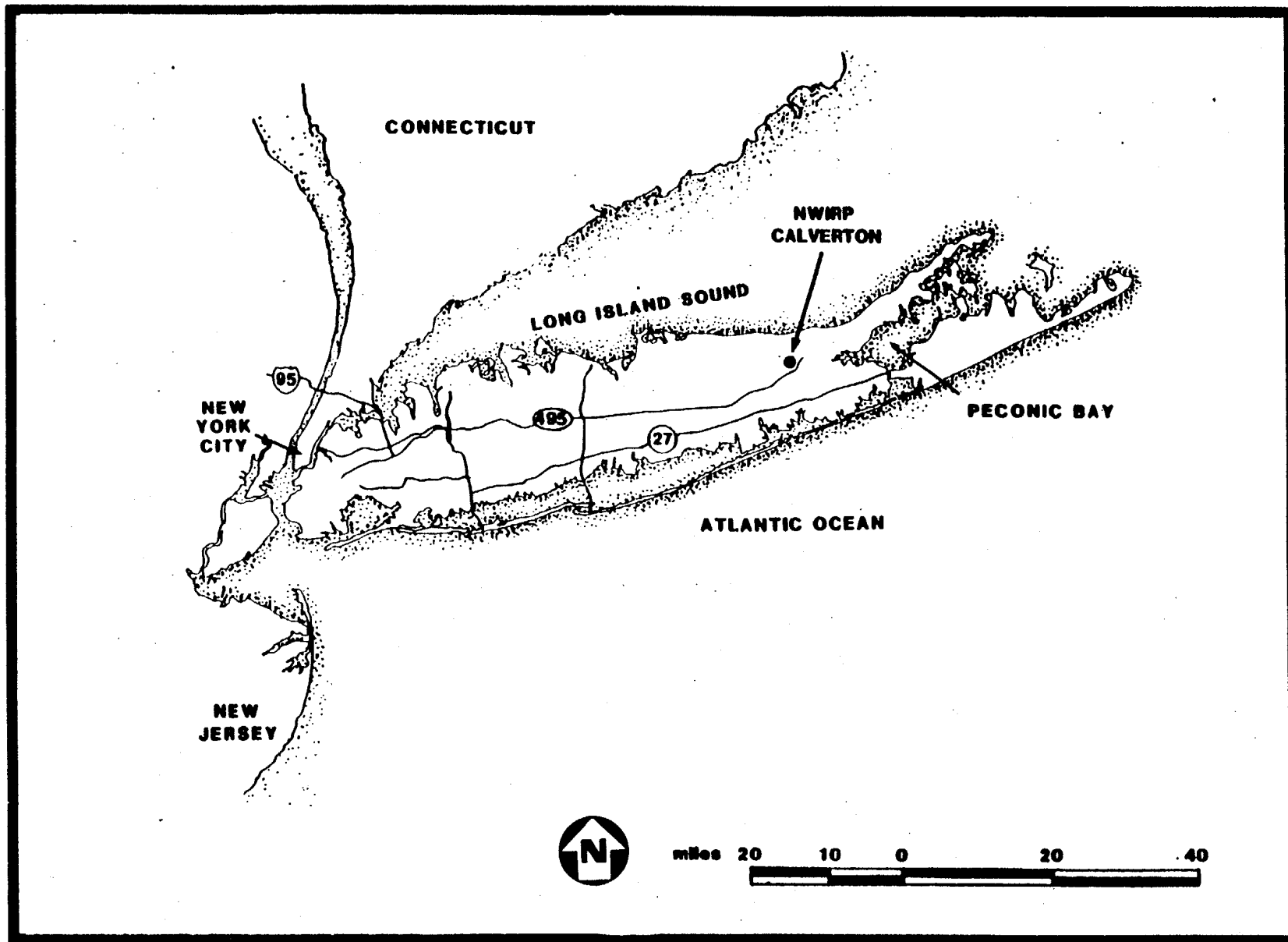
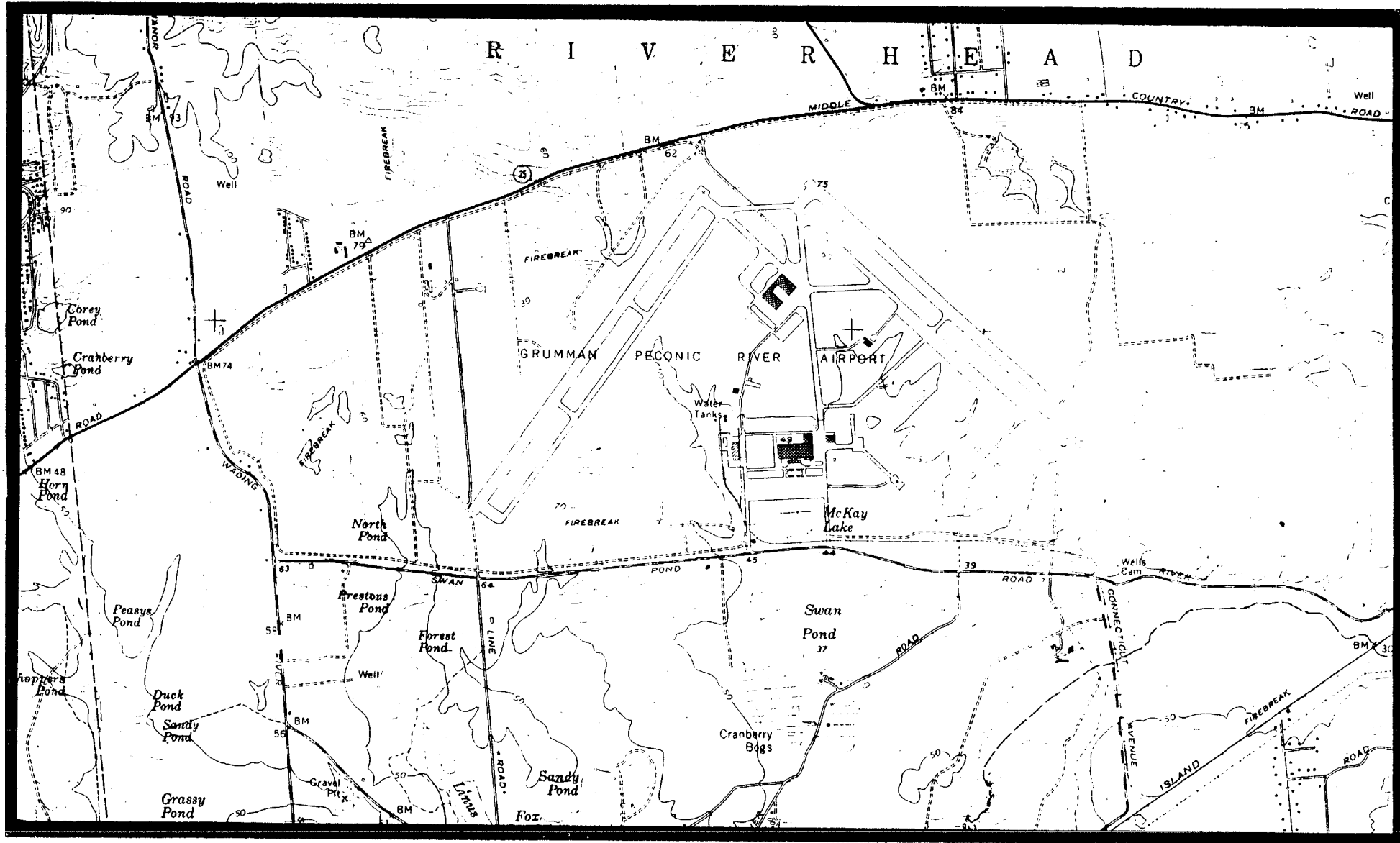


FIGURE 1-1

GENERAL LOCATION MAP
RFA - SV WORK PLAN
NWIRP, CALVERTON, NEW RK

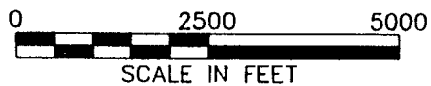
 **HALLIBURTON NUS**
Environmental Corporation

A-1-3



USGS QUADRANGLE: WADING RIVER 1967

FIGURE 1-2



SITE LOCATION
RFA - SV WORK PLAN
NWIRP, CALVERTON, NEW YORK



HALLIBURTON NUS
Environmental Corporation

This study is being conducted as result of a Site Investigation conducted by Halliburton NUS in 1991 and 1992. The findings of the Site Investigation are summarized in the following paragraphs.

Summary of SI Report Conclusions and Recommendations

As a follow-up to the U.S. Navy Initial Assessment Study performed in 1986, as well as additional findings since that time, seven sites were studied in a Site Investigation at the NWIRP in Calverton, New York. These sites were classified as either landfill-type sites or sites resulting from documented or suspected historic spills or leaks of fuels, oils, and/or solvents.

The two landfill-type sites are the northeast pond disposal area (Site 1) and the picnic grounds disposal area (Site 4). There are no reports of hazardous material being disposed in either of these sites. The sites considered because of documented or suspected spills or leaks are the fire training area (Site 2), the fuel calibration area (Site 6A), the engine runup area (Site 6B), the south end of runway 32-14 (Site 6C), and the fuel depot area (Site 7). The presence of free floating products in monitoring wells installed at Sites 2, 6A, and 7, is a direct indication of historic spills or leaks. Sites 6B, 6C, and the engine runup area and engine test house at Site 6A were considered because of the visual observation of stressed vegetation at these areas. These areas with stressed vegetation correlate to the locations where exhaust from jet engines is common.

Volatile organic compounds found during the SI at one or more of the sites included chlorinated alkanes (e.g. 1,1,1-trichloroethane), chlorinated alkenes (e.g., tetrachloroethene), and aromatic compounds, (e.g., benzene and toluene). Semivolatile organic compounds found at one or more of the sites included phthalates and polyaromatic hydrocarbons. The inorganic compounds found at concentrations above natural background concentrations at one or more sites included chromium, cadmium, lead, copper, zinc, and cyanide.

The most significant contaminants detected during the SI in the soils at the northeast pond disposal area (Site 1) included naphthalene (1,700J ug/kg), PAHs (182,500J ug/kg), cadmium (42.2 mg/kg), chromium (959 mg/kg), copper (1,320J mg/kg), lead (314J mg/kg), nickel (233 mg/kg), and zinc (2,380J mg/kg). Low concentrations of surface water and sediment contamination were also found.

The most significant contaminants detected during the SI in the soils at the fire training were (Site 2) include chloroethane (230J ug/kg), tetrachloroethene (580 ug/kg), toluene (4,300 ug/kg), ethylbenzene (1,500 ug/kg), PAHs (31,310J ug/kg), aldrin (36 ug/kg), PCBs (8,500 ug/kg), and lead (41.6J mg/kg). The most significant contaminants detected in the groundwater at Site 2 included chloroethane (4,500 ug/l), 1,1-dichloroethane (1,700 ug/l), toluene

(320 ug/l), 1,2-dichlorobenzene (74 ug/l), PCBs (7.9 ug/l), Cadmium (22.8 ug/l), chromium (80.3 ug/l), lead (73.8 ug/l), and zinc (21.3 ug/l).

The SI identified minimal contamination at the picnic grounds disposal area (Site 4). The most significant contaminants detected in the soils at Site 4 included 1,2-dichloroethane (7 ug/kg) and lead (21.3 mg/kg).

The most significant contaminants detected during the SI in the soils at the fuel calibration area (Site 6A) included 1,1,1-trichloroethane (7,400J ug/kg), toluene (1,300J ug/kg), xylene (17,000J ug/kg), and lead (21.2J mg/kg). The most significant contaminants detected in the groundwater at Site 6A included chloroethane (2,600 ug/l), 1,1-dichloroethane (300 ug/l), 1,1,1-trichloroethane (23 ug/l), toluene (140 ug/l), and lead (1,740 ug/l). Minimal contamination was found in the sediments at this site.

The SI identified minimal contamination at engine runup and end of runway 32-14 areas (Sites 6B and 6C). The most significant soils contamination detected was PAHs (493J ug/kg).

Minimal contamination was found during the SI in the soils at the fuel depot area (Site 7). The most significant contaminant detected was PAHs (4,750J mg/kg). However, more significant groundwater contamination was found. The groundwater contaminants included benzene (390 ug/l), toluene (540 ug/l), xylene (960 ug/l), and lead (692 ug/l).

During the SI, low, but significant, concentrations of several volatile organic compounds were detected in the groundwater from production wells near the fuel depot. These contaminants included 1,1-dichloroethane (3J ug/l) and 1,1,1-trichloroethane (5 ug/l).

Based on the results of the SI, it was recommended that additional investigation be conducted to quantify the nature and extent of contamination as well as the potential risks to human health and the environment for the following media and sites:

The soils at Sites 1, 2, 6A (except for the engine runup area and the engine test house), and potentially Site 7.

The groundwater at Sites 1, 2, 6A (except for the engine runup area and the engine test house), and Site 7.

The surface water and sediments at Site 1.

The soils (including the former coal pile) and contaminated groundwater associated with the Productions Wells. This area is being investigated as part of a RCRA Facility Assessment (RFA) currently being conducted by Halliburton NUS.

Additional investigation of past practices were also recommended to evaluate other potential source areas of contamination, including abandoned leach field throughout the NWIRP.

No additional investigation was recommended in the SI Report for the picnic grounds disposal area (Site 4), the engine runup area or engine test house at Site 6A, the engine runup area (Site 6B), or the end of runway 32-14 (Site 6C).

1.3 SCOPE OF WORK

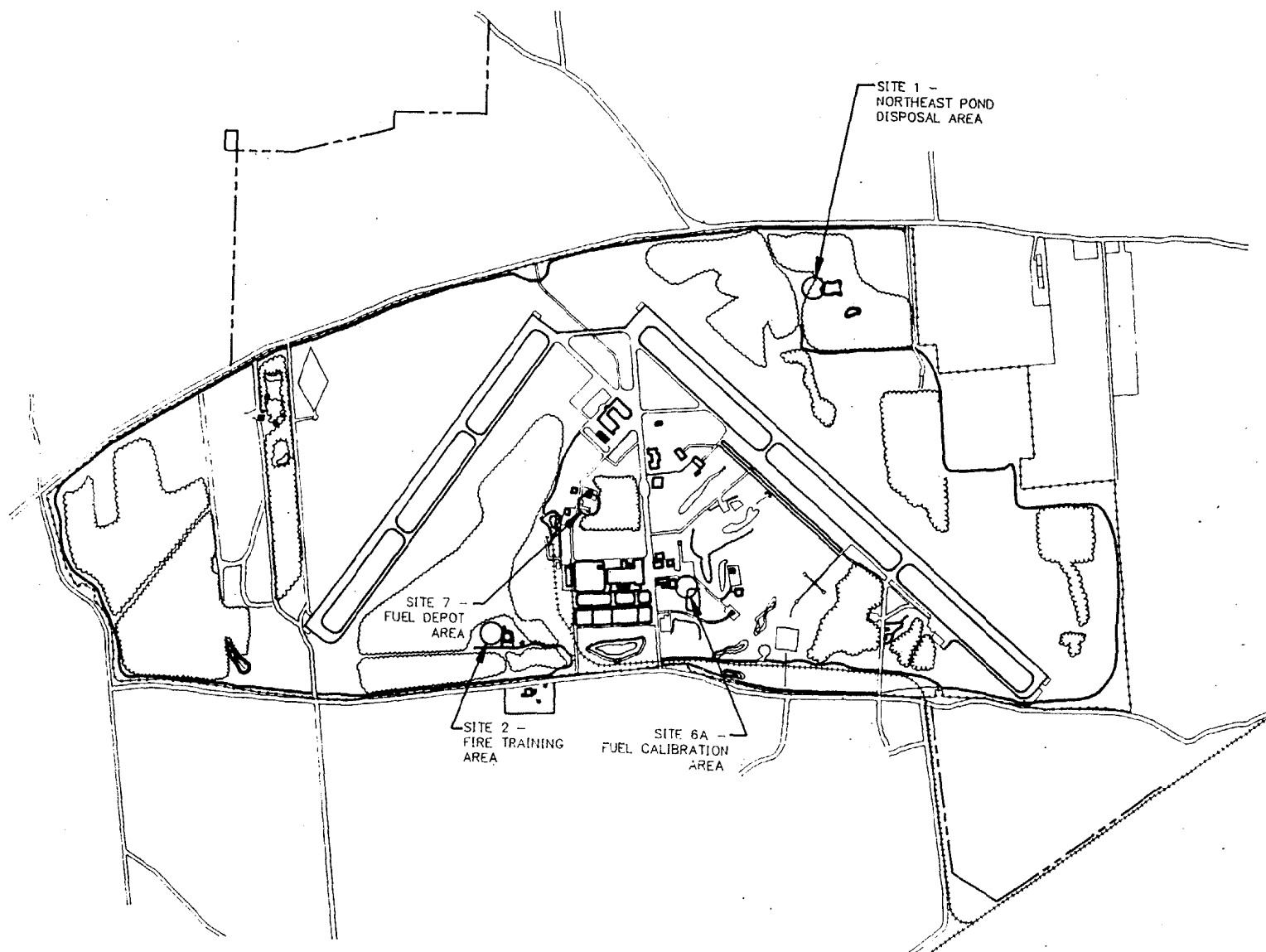
Halliburton NUS has been tasked to perform a RFI Work Plan for four sites at the NWIRP Calverton. In 1986, an Initial Assessment Study (IAS) identified potentially contaminated sites at NWIRP Calverton (RGH, 1986). Based on the IAS, a Site Investigation (SI) was conducted for the NWIRP Calverton between July 1991 through April 1992 (Halliburton NUS, 1992). This SI evaluated environmental contamination at seven areas. Environmental contamination has been confirmed at four of these areas, which are being addressed in this work plan. These areas are the Site 1 - Northeast Pond Disposal Area (SWMU 1), Site 2 - Fire Training Area (SWMU 13), Site 6A - Fuel Calibration Area (AOC 1A), and Site 7 - Fuel Depot. Contaminants detected at one or more of these sites include solvents, fuels, heavy metals, and PCBs/pesticides.

The location of each of these areas is presented in Figure 1-3.

1.4 SAMPLE MATRICES, PARAMETERS, AND FREQUENCY COLLECTION

As part of the RFI, environmental samples will be collected from the following matrices: soil, sediment, groundwater, surface water, and waste. A listing of the sample matrices, analytical parameters, and frequency of collection is presented in Tables 1-1 through 1-4. Table 3-1 (Section 3.0) presents a full listing of all analytical parameters, container, volume, preservation, holding time, and methodology requirements. Table 3-2 (Section 3.0) presents the the analytes which are included in the TCLP analyses. Sampling protocols to be used in this study are provided in Section 4.0 of this Work Plan.

A-1-7



LOCATION OF SITES
RFI WORK PLAN
NWIRP, CALVERTON, NY

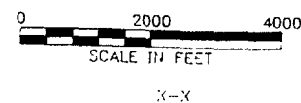


FIGURE 1-3

TABLE 1-1

**SITE 1 - NORTHEAST POND DISPOSAL AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
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TEST PIT SOIL SAMPLES

9/9	1	-	1	2	NA	12	PCB/pesticides and TAL inorganics	ILM 02.1
4/9	1	-	1	1	2	8	TCL volatiles and TCL semivolatiles	OLM 01.8
2/9	1	-	NA	NA	NA	3	Engineering parameters ⁶	(6)

SUBSURFACE SOIL BORING SAMPLES

13/13	2	2	1	1	NA	18	PCB/pesticides and TAL inorganics	ILM 02.1
3/13	1	2	1	1	1	8	TCL volatiles and TCL semivolatiles	OLM 01.8

SURFACE SOIL SAMPLES

6/6	1	-	1	1	NA	8	TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
1/6	1	-	NA	NA	NA	2	Engineering parameters ⁶	(6)

GROUNDWATER SAMPLES - PERMANENT WELLS

4/4	1	-	1	1	1	7	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and hexavalent chromium	OLM 01.8/ ILM 02.1/ E218.5
4/4 ^(b)	1	-	1	1	1	7		
1/4	1	-	NA	NA	NA	2	Engineering parameters ⁷	(7)

SURFACE WATER SAMPLES

4/4	1	-	1	1	1	7	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and hexavalent chromium	OLM 01.8/ ILM 02.1/ E218.5
1/4	1	-	NA	NA	NA	2	Engineering parameters ⁷	(7)

TABLE 1-1 (continued)
SITE 1 - NORTHEAST POND DISPOSAL AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
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SEDIMENT SAMPLES

12/12	2	-	1	1	1	16	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
1/12	1	-	NA	NA	NA	2	Engineering parameters ⁶ excluding BTU content and TCLP characterization	(6)

WASTE SAMPLES

5	1	-	1	1	1	8	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, ignitability, corrosivity, reactivity, and other engineering parameters ⁶	OLM 01.8/ ILM 02.1/ SW7195/(6)
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- 1 - The number of samples out of the field samples (not including the QA/QC samples) to be analyzed as specified.
 - 2 - Field blank consist of one driller's decontamination water and one analyte-free water used for decontamination and rinsate. Frequency of analysis is one sample/water source/event.
 - 3 - Sample collected with additional volume for MS/MSD/LD analyses, therefore this number is not used to calculate the total number of samples.
 - 4 - Collected on a 1/day/media frequency. (Sample from every other day analyzed initially). # shown reflects # analyzed.
 - 5 - TCL Volatiles only.
 - 6 - Engineering parameters include particle size (ASTM D421 and D422), bulk density (MSA), moisture content (ASTM D2216), TOC (Walkley-Black), TPH (E418.1), BTU content (ASTM D3286), and TCLP characterization (40 CFR 261).
 - 7 - Engineering parameters include temperature, pH, TSS (E160.1), TDS (E160.2), alkalinity (E310.1), hardness (E130.2), TOC (E415.1), BOD (SM 5210B), and COD (E410.2).
 - 8 - Samples to be collected during Round 2.
- NA - Not applicable.

TABLE 1-2

**SITE 2 - FIRE TRAINING AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
TEST PIT SOIL SAMPLES								
11/11	2	-	2	2	2	17	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
2/11	1	-	NA	NA	NA	3	Engineering parameters ⁶	(6)
SUBSURFACE SOIL BORING SAMPLES								
25	3	-	1	1	2	31	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
SURFACE SOIL SAMPLES								
6/6	1	-	1	1	NA	8	TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
1/6	1	-	NA	NA	NA	2	Engineering parameters ⁶	(6)
GROUNDWATER SAMPLES - PERMANENT WELLS								
11/11	2	-	1	1	1	15	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics	OLM 01.8/ ILM 02.1
11/11 ⁽⁶⁾	2	-	1	1	1	15		
2/11	1	-	NA	NA	NA	3	Engineering parameters ⁷	(7)
GROUNDWATER SAMPLES - TEMPORARY WELLS								
40/40	4	-	2	2	4	50	Selected volatile organics (onsite)	SW846/5030/ 8010
4/40	1	-	1	1	1	7	Selected volatile organics (offsite)	OLM 01.8
SOIL GAS SAMPLES								
140	14	-	NA	NA	NA	154	Selected volatile organics (onsite)	SW846 8010/ 8020/ 5030

TABLE 1-2 (continued)
SITE 2 - FIRE TRAINING AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
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WASTE SAMPLES

5	1	-	1	1	1	8	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, ignitability, corrosivity, reactivity, and other engineering parameters ⁶	OLM 01.8/ ILM 02.1/ SW7195/(6)
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- 1 - The number of samples out of the field samples (not including the QA/QC samples) to be analyzed as specified
 - 2 - Field blank consist of one driller's decontamination water and one analyte-free water used for decontamination and rinsate. Frequency of analysis is one sample/water source/event.
 - 3 - Sample collected with additional volume for MS/MSD/LD analyses, therefore this number is not used to calculate the total number of samples.
 - 4 - Collected on a 1/day/media frequency. (Sample from every other day analyzed initially). # shown reflects # analyzed.
 - 5 - TCL volatiles only.
 - 6 - Engineering parameters include particle size (ASTM D421 and D422), bulk density (MSA), moisture content (ASTM D2216), TOC (Walkley-Black), TPH (E418.1), BTU content (ASTM D3286), and TCLP characterization (40 CFR 261).
 - 7 - Engineering parameters include temperature, pH, TSS (E160.1), TDS (E160.2), alkalinity (E310.1), hardness (E130.2), TOC (E415.1), BOD (SM 5210B), and COD (E410.2).
 - 8 - Samples to be collected during Round 2.
- NA - Not applicable.

TABLE 1-3

**SITE 6A - FUEL CALIBRATION AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
SUBSURFACE SOIL BORING SAMPLES								
35/35	4	-	2	1	3	43	TCL volatiles, TCL semivolatiles, and lead	OLM 01.8/ ILM 02.1
2/35	1	-	NA	NA	NA	3	Engineering parameters ⁶ , TAL metals	(6), ILM 02.1
SURFACE SOIL SAMPLES								
6/6	1	-	1	1	NA	8	TCL semivolatiles and lead	OLM 01.8/ ILM 02.1
1/6	1	-	NA	NA	NA	2	Engineering parameters ⁶	(6)
GROUNDWATER SAMPLES - PERMANENT WELLS								
10/10 10/10 ⁽⁹⁾	1 1	- -	1 1	1 1	2 2	14 14	TCL volatiles, TCL semivolatiles and lead; If free product found, BTU content, organic lead and PCB/pesticides also	OLM 01.8/ ILM 02.1/ ASTM D3286/
2/10	1	-	NA	NA	NA	3	Engineering parameters ⁷	(7)
GROUNDWATER SAMPLES - TEMPORARY WELLS								
40/40	4	-	2	2	4	50	Selected volatile organics (onsite)	SW 846 5030/ 8010
4/40	1	-	1	1	1	7	Selected volatile organics (offsite)	OLM 01.8

TABLE 1-3 (continued)
SITE 6A - FUEL CALIBRATION AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
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SOIL GAS SAMPLES

150	15	NA	NA	NA	NA	165	Selected volatile organics (onsite)	SW846 8010/8020
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- 1 - The number of samples out of the field samples (not including the QA/QC samples) to be analyzed as specified.
 - 2 - Field blank consist of one driller's decontamination water and one analyte-free water used for decontamination and rinsate. Frequency of analysis is one sample/water source/event.
 - 3 - Sample collected with additional volume for MS/MSD/LD analyses, therefore this number is not used to calculate the total number of samples.
 - 4 - Collected on a 1/day/media frequency. (Sample from every other day analyzed initially). # shown reflects # analyzed.
 - 5 - TCL Volatiles only.
 - 6 - Engineering parameters include particle size (ASTM D421 and D422), bulk density (MSA), moisture content (ASTM D2216), TOC (Walkley-Black), TPH (E418.1), BTU content (ASTM D3286), and TCLP characterization (40 CFR 261).
 - 7 - Engineering parameters include temperature, pH, TSS (E160.1), TDS (E160.2), alkalinity (E310.1), hardness (E130.2), TOC (E415.1), BOD (SM 5210B), and COD (E410.2).
 - 8 - Samples to be collected during Round 2.
- NA - Not applicable.

TABLE 1-4

**SITE 7 - FUEL DEPOT AREA
FIELD AND QA/QC SAMPLES RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Number of Samples ¹	Number of Duplicates	Number of Field Blanks ²	Number of MS/MSD/LD ³	Number of Rinsate Blanks ⁴	Number of Trip Blanks ⁵	Total Number of Samples	Analysis	Analytical Method
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SUBSURFACE SOIL BORING SAMPLES

10/10	1	-	1	1	1	13	TCL volatiles, TCL semivolatiles, and lead	OLM 01.8/ ILM 02.1
1/10	1	-	NA	NA	NA	2	Engineering parameters ⁶	(6)

GROUNDWATER SAMPLES - PERMANENT WELLS

10/10	1	-	1	1	1	13	TCL volatiles, TCL semivolatiles, and lead; if free product found, BTU content, organic lead, and PCB/pesticides also	OLM 01.8/ ILM 02.1/ ASTM D3286
10/10 ⁸	1	-	1	1	1	13		
2/10	1	-	NA	NA	NA	3	Engineering parameters ⁷	(7)

GROUNDWATER SAMPLES - TEMPORARY WELLS

30/30	3	-	2	1	3	37	Selected volatile organics (onsite)	SW 846/8010/ 5030
3/30	1	-	1	1	1	6	Selected volatile organics (offsite)	OLM 01.8

SOIL GAS SAMPLES

70	7	-	NA	NA	NA	77	Selected volatile organics (onsite)	SW846 8010/ 8020
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- 1 - The number of samples out of the field samples (not including the QA/QC samples) to be analyzed as specified.
 - 2 - Field blank consist of one driller's decontamination water and one analyte-free water used for decontamination and rinsate. Frequency of analysis is one sample/water source/event.
 - 3 - Sample collected with additional volume for MS/MSD/LD analyses, therefore this number is not used to calculate the total number of samples.
 - 4 - Collected on a 1/day/media frequency. (Sample from every other day analyzed initially). # shown reflects # analyzed.
 - 5 - TCL Volatiles only.
 - 6 - Engineering parameters include particle size (ASTM D421 and D422), bulk density (MSA), moisture content (ASTM D2216), TOC (Walkley-Black), TPH (E418.1), BTU content (ASTM D3286), and TCLP characterization (40 CFR 261).
 - 7 - Engineering parameters include temperature, pH, TSS (E160.1), TDS (E160.2), alkalinity (E310.1), hardness (E130.2), TOC (E415.1), BOD (SM 5210B), and COD (E410.2).
 - 8 - Samples to be collected during Round 2.
- NA - Not applicable.

1.5 QUALITY ASSURANCE OVERVIEW

Halliburton NUS has established quality assurance/quality control (QA/QC) measures and a program to ensure that these measures are applied to the collection and interpretation of environmental quality data at the NWIRP facility. The work plan is designed to assure that the precision, accuracy, representativeness, comparability, and completeness (the PARCC parameters) of the data are known, documented, and adequate to satisfy the data quality objectives of the study.

This plan presents the policies, organization, objectives, data-collection activities, and QA/QC activities that will be utilized to ensure that all data collected during, and reported by, this study are representative of existing conditions. Chemical testing will be conducted by a laboratory subcontractor. The laboratory will have prior Naval Energy and Environmental Support Activity (NEESA) approval. QA/QC procedures for the chemical analysis will conform to or exceed the requirements of the NYSDEC Analytical Services Protocols (ASP) and will satisfy NEESA requirements for Level D QC.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Halliburton NUS will be responsible for the overall management of the project, including the field inspection and conduct of all drilling, excavation, and sampling activities. Personnel from the Navy will be actively involved in the investigation and will coordinate with personnel from Halliburton NUS in a number of areas.

2.1 PROJECT ORGANIZATION

The key firms and personnel involved in the RFI, as well as the chain-of-communication and responsibility of the project personnel are as follows. The Navy Remedial Project Manager is responsible for the overall management of the IR Program for the NWIRP Calverton.

Northern Division
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113
(215) 595-0567

Debra Felton, P.E (Code 1821)
Remedial Project Manager

The project is being conducted by Halliburton NUS.

Halliburton NUS Environmental Corporation
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania
(412) 931-7090

David D. Brayack, P.E.
Project Manager

Mark L. Mengel
Field Operations Leader

Debra Scheib
Quality Assurance/Quality Control (QA/QC) Advisor

Matthew Soltis
Health and Safety Specialist

The Project Manager has the primary responsibility for project and technical management of this project. He is responsible for the coordination of all onsite personnel, and for providing technical assistance for all activities that are directly related to the determination of the environmental quality of the site. If quality assurance problems or deficiencies requiring specific action are identified, the project manager and project QA/QC advisor will identify the appropriate corrective action.

2.2 FIELD ORGANIZATION

The Halliburton NUS field investigation team will be organized according to the activity planned. For onsite sampling, the sampling team members will be selected based upon the type and extent of effort required. The team will consist of a combination of the following personnel.

Field Operation Leader (FOL)
Field Geologist
QA/QC advisor
Site health and safety specialist

The FOL will be responsible for the coordination of all onsite personnel and for providing technical assistance when required. The FOL, or designee, will coordinate and be present during all sampling activities and will assure the availability and maintenance of all sampling materials and equipment. The FOL will be responsible for the completion of all sampling and chain-of-custody documentation, will assume custody of all samples, and ensure the proper handling and shipping of samples.

The FOL will also be responsible for providing technical supervision of the drilling subcontractor and for maintaining a geologic log of all borings drilled. Copies of the forms to be used in this investigation are provided as Appendix B.

The QA/QC advisor will be responsible for the adherence of all QA/QC guidelines as defined in this work plan. Strict adherence to these procedures is critical to the collection of acceptable and representative data.

The site health and safety specialist will be responsible for assuring that all team members adhere to the site health and safety requirements. Additional responsibilities of the site health and safety specialist are as follows:

- Updating equipment or procedures based upon new information gathered during the site operation.
- Modifying the levels of protection based upon site observations.
- Determining and posting locations and routes to medical facilities, including poison control centers, and arranging for emergency transportation to medical facilities.
- Notifying local public emergency officers, including police and fire departments, of the nature or the team's operations and for posting these department's telephone numbers.
- Examining work-party members for symptoms of exposure of stress.
- Providing emergency medical care and first aid as necessary on site. The site health and safety manager also has the responsibility to stop any field operation that threatens the health or safety of the team or the surrounding populace.

2.3. LABORATORY OPERATIONS

Analysis of all environmental samples will be performed by a NEESA-approved laboratory. The laboratory work will be performed in accordance with QC level D guidance as stipulated in the NEESA guidelines (20.2-0478; 6/88), which requires CLP methods and CLP-type deliverables. The QA/QC procedures should meet or exceed NYSDEC requirements.

3.0 QUALITY ASSURANCE OBJECTIVES FOR DATA MANAGEMENT

The overall QA objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide environmental monitoring data of known and acceptable quality. Specific procedures to be used for sampling, chain-of-custody, calibration of field instruments, laboratory analysis, reporting, internal quality control, audits, preventative maintenance, and corrective actions are described in later sections of this work plan. The purpose of this section is to address the data quality objectives in terms of the (PARCC) parameters, quantitation and detection limits, field blanks, trip blanks, rinsate blanks, and bottleware cleanliness.

3.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and/or quantitative statements regarding the quality of data needed to support the RFI activities. The sampling rationale provided in Section 4.0 of this work plan explains the choice of sample locations and media which will supply information needed for the RFI. The use of Contract Laboratory Program (CLP) analyses listed in Table 3-1 following current CLP SOW protocols is expected to satisfy data quality needs in accordance with NEESA, NYSDEC, and CLP requirements. Table 3-2 provides a list of the RCRA TCLP parameters.

3.2 QUANTITATION LIMITS

Both aqueous and solid quantitation limits are those required as Contract Required Quantitation Limits (CRQLs - for organics) and Contract Required Detection Limits (CRDLs - for inorganics) for a current CLP SOW with allowances for dilutions and dry weight conversions. The CRQLs and CRDLs for the 1990 SOW are presented in Table 3-1. The laboratory also reports Method Detection Limits (MDLs) and Instrument Detection Limits (IDLs). These limits, by contract, must be equal to or less than the CRQLs and CRDLs, respectively. For the RFI report, the MDLs and IDLs of the laboratory selected and instruments used will be presented. For soil gas measurements, the detection limit for each chemical is expected to be about 1 ug/l. The actual detection limit is based on vendor selected and instruments used. These detection limits will also be documented.

3.3 DETECTION LIMITS

Instrument detection limits (IDL) and method detection limits (MDL) are reported under CLP protocol. The IDLs and MDLs applicable at the date of analysis will be supplied in each data package. IDLs and MDLs must be less than or equal to CRDLs and CRQLs.

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRQL ($\mu\text{g/L}$)	Methodology
<u>TCL Volatile Organic Compounds</u>	G, Teflon-lined septum Three 40-ml vials	Cool, 4°C HCl to pH <2	14 days		CLP SOW ¹ /OLM 01.8
Chloromethane				10	
Bromomethane				10	
Vinyl Chloride				10 ²	
Chloroethane				10	
Methylene Chloride				10	
Acetone				10	
Carbon Disulfide				10	
1,1-Dichloroethene				10	
1,1-Dichloroethane				10	
1,2-Dichloroethene (total)				10	
Chloroform				10	
1,2-Dichloroethane				10	
2-Butanone				10	
1,1,1-Trichloroethane				10	
Carbon Tetrachloride				10	
Vinyl Acetate				10	
Bromodichloromethane				10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
 REQUIREMENTS
 RFI WORK PLAN
 NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRQL ($\mu\text{g/L}$)	Methodology
<u>TCL Volatile Organic Compounds</u> (Continued)	G, Teflon-lined septum Three 40-ml vials	Cool, 4°C HCl to pH <2	14 days		CLP SOW'/OLM 01.8
1,2-Dichloropropane				10	
cis-1,3-Dichloropropane				10	
Trichloroethene				10	
Dibromochloromethane				10	
1,1,2-Trichloroethane				10	
Benzene				10	
trans-1,3-Dichloropropane				10	
Bromoform				10	
4-Methyl-2-pentanone				10	
2-Hexanone				10	
Tetrachloroethene				10	
Toluene				10	
1,1,2,2-Tetrachloroethane				10	
Chlorobenzene				10	
Ethyl Benzene				10	
Styrene				10	
Xylenes (total)				10	
Trichlorodifluoroethane				10	
Trichlorotrifluoroethane				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TCL Semivolatile Compounds</u>	G, Teflon-lined cap two 80-oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW'/OLM 01.8
Phenol				10	
bis(2-Chloroethyl)ether				10	
2-Chlorophenol				10	
1,3-Dichlorobenzene				10	
1,4-Dichlorobenzene				10	
Benzyl Alcohol				10	
1,2-Dichlorobenzene				10	
2-Methylphenol				10	
bis(2-Chloroisopropyl)ether				10	
4-Methylphenol				10	
n-Nitroso-di-n-dipropylamine				10	
Hexachloroethane				10	
Nitrobenzene				10	
Isophorone				10	
2-Nitrophenol				10	
2-4-Dimethylphenol				50	
Benzoic Acid				10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS

RFI WORK PLAN

NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TCL Semivolatile Compounds</u> (Continued)	G, Teflon-lined cap two 80-oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
bis(2-Chloroethoxy)methane				10	
2,4-Dichlorophenol				10	
1,2,4-Trichlorobenzene				10	
Naphthalene				10	
4-Chloroaniline				10	
Hexachlorobutadiene				10	
4-Chloro-3-methylphenol (para-chloro-meta-cresol)				10	
2-Methylnaphthalene				10	
Hexachlorocyclopentadiene				10	
2,4,6-Trichlorophenol				10	
2,4,5-Trichlorophenol				50	
2-Chloronaphthalene				10	
2-Nitroaniline				50	
Dimethylphthalate				10	
Acenaphthylene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TCL Semivolatile Compounds</u> <u>(Continued)</u>	G, Teflon-lined cap two 80- oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
2,6-Dinitrotoluene				10	
3-Nitroaniline				50	
Acenaphthene				10	
2,4-Dinitrophenol				50	
4-Nitrophenol				50	
Dibenzofuran				10	
Diethylphthalate				10	
4-Chlorophenyl-phenyl ether				10	
Fluorene				10	
4-Nitroaniline				50	
4,6-Dinitro-2-methylphenol				50	
n-Nitrosodiphenylamine				10	
4-Bromophenyl-phenyl ether				10	
Hexachlorobenzene				10	
Pentachlorophenol				50	
Phenanthrene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TCL Semivolatile Compounds</u> (Continued)	G, Teflon-lined cap two 80-oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
Anthracene				10	
Di-n-butylphthalate				10	
Fluoranthene				10	
Pyrene				10	
Butylbenzylphthalate				10	
3,3'-Dichlorobenzidine				20	
Benzo(a)anthracene				10	
Chrysene				10	
bis(2-Ethylhexyl)phthalate				10	
Di-n-octylphthalate				10	
Benzo(b)fluoranthene				10	
Benzo(k)fluoranthene				10	
Benzo(a)pyrene				10	
Indeno(1,2,3-cd)pyrene				10	
Dibenz(a,h)anthracene				10	
Benzo(g,h,i)perylene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TCL Pesticides/PCBs</u>	G, Teflon-lined cap two 80-oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
alpha-BBC				0.05	
beta-BHC				0.05	
delta-BHC				0.05	
gamma-Bhc (lindane)				0.05	
Heptachlor				0.05	
Aldrin				0.05	
Heptachlor Epoxide				0.05	
Endosulfan I				0.05	
Dieldrin				0.10	
4,4'-DDE				0.10	
Endrin				0.10	
Endosulfan II				0.10	
4,4'-DDD				0.10	
Endosulfan Sulfate				0.10	
4,4'-DDT				0.10	
Methoxychlor				0.5	
Endrin Ketone				0.10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS

RFI WORK PLAN

NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
TCL Pesticides/PCBs (Continued)	G, Teflon-lined cap two 80-oz. amber jugs	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
alpha-Chlordane				0.5	
gamma-Chlordane				0.5	
Toxaphene				1.0	
Aroclor-1016				0.5	
Aroclor-1221				0.5	
Aroclor-1232				0.5	
Aroclor-1242				0.5	
Aroclor-1248				0.5	
Aroclor-1254				1.0	
Aroclor-1260				1.0	

- 1) Contract Laboratory Program Statement of Work - CRQL's and CRDL's presented are for 1990 SOW. CRQL's and CRDL's will vary with dilution factor and sample percent solids.
- 2) The NYSDEC groundwater action level for vinyl chloride is 2 ug /L.

NA - Not applicable.

CRDL - Contract Required Detection Limits

CRQL - Contract Required Quantitation Limits

P - Polyethylene

G - Glass

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TAL Metals, Cyanide</u>	P; one 1-liter bottle total	HNO ₃ to pH<2 Cool, 4°C	180 days		CLP SOW ¹ /ILM 02.1
Aluminum				200	
Antimony				60	
Arsenic				10	
Barium				200	
Beryllium				5	
Cadmium				5	
Calcium				5,000	
Chromium				10	
Cobalt				50	
Copper				25	
Iron				100	
Lead				3	
Magnesium				5,000	
Manganese				15	
Mercury			28 days	0.2	
Nickel				40	
Potassium				5,000	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
<u>TAL Metals, Cyanide</u> (Continued)	P; one 1-liter bottle total	HNO ₃ to pH <2 Cool, 4°C	180 days		CLP SOW ¹ /ILM 02.1
Selenium				5	
Silver				10	
Sodium				5,000	
Thallium				10	
Vanadium				50	
Zinc				20	
Cyanide	P; one 1-liter bottle	NaOH pH > 12 Cool 4°C	14 days	10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

A. Groundwater and Surface Water Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/L)	Methodology
Additional Analytes					
Chromium VI	P; one 1-liter bottle total	Cool 4°C	24 hours	NA	EPA 218.4
Hardness	P; one 1-liter bottle	HNO ³ to pH <2 Cool 4°	180 days	10 mg/l	EPA 130.2
Alkalinity	P; one 1-liter bottle	Cool 4°C	14 days	1 mg/L	EPA 310.1
Total Organic Carbon	P; one 1-liter bottle	H ₂ SO ₄ to pH <2 Cool 4°C	28 days	5 mg/L	EPA 415.1
Total Dissolved Solids	P; one 1-liter bottle	Cool 4°C	7 days	10 mg/L	EPA 160.1
Total Suspended Solids	P; one 1-liter bottle	Cool 4°C	7 days	4 mg/l	EPA 160.2
Biochemical Oxygen Demand, 5-day	P; one 1-liter bottle	Cool 4°C	48 hours	1 mg/L	EPA 4051
Chemical Oxygen Demand	P; one 1-liter bottle	H ₂ SO ₄ to pH <2 Cool 4°C	28 days	5 mg/L	EPA 410.2
Total Petroleum Hydrocarbons	G; one 1-liter amber	HCl to pH <2 Cool 4°C	28 days	1 mg/L	EPA 418.1
BTU	G; one 16 oz. glass	NA	28 days	NA	ASTM D3286
Organic Lead	P; 1-liter bottle	HNO ₃ pH <2 Cool 4°C	180 days	NA	MSA Chapter 21

- 1) Contract Laboratory Program Statement of Work - CRQL's and CRDL's presented are for 1990 SOW. CRQL's and CRDL's will vary with dilution factor and sample percent solids.
 NA - Not applicable
 CRDL - Contract Required Detection Limits
 CRQL - Contract Required Quantitation Limits
 P - Polyethylene
 G - Glass

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRQL ($\mu\text{g/kg}$)	Methodology
<u>TCL Volatile Organic Compounds</u>	G, Teflon-lined septum Three 60-ml vials	Cool, 4°C	10 days from time of sample collection.		CLP SOW ¹ /OLM 01.8
Chloromethane				10	
Bromomethane				10	
Vinyl Chloride				10	
Chloroethane				10	
Methylene Chloride				10	
Acetone				10	
Carbon Disulfide				10	
1,1-Dichloroethene				10	
1,1-Dichloroethane				10	
1,2-Dichloroethene (total)				10	
Chloroform				10	
1,2-Dichloroethane				10	
2-Butanone				10	
1,1,1-Trichloroethane				10	
Carbon Tetrachloride				10	
Vinyl Acetate				10	
Bromodichloromethane				10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS

RFI WORK PLAN

NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRQL ($\mu\text{g}/\text{kg}$)	Methodology
<u>TCL Volatile Organic Compounds</u> (Continued)	G, Teflon-lined septum Three 60-mL vials	Cool, 4°C	10 days from time of sample collection.		CLP SOW ¹ /OLM 01.8
1,2-Dichloropropane				10	
cis-1,3-Dichloropropane				10	
Trichloroethene				10	
Dibromochloromethane				10	
1,1,2-Trichloroethane				10	
Benzene				10	
trans-1,3-Dichloropropane				10	
Bromoform				10	
4-Methyl-2-pentanone				10	
2-Hexanone				10	
Tetrachloroethene				10	
Toluene				10	
1,1,2,2-Tetrachloroethane				10	
Chlorobenzene				10	
Ethyl Benzene				10	
Styrene				10	
Xylenes (total)				10	
Trichlorodifluoroethane				10	
Trichlorotrifluoroethane				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/kg)	Methodology
<u>TCL Semivolatile Compounds</u>	G, Teflon-lined cap 1, 8-oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
Phenol				10	
bis(2-Chloroethyl)ether				10	
2-Chlorophenol				10	
1,3-Dichlorobenzene				10	
1,4-Dichlorobenzene				10	
Benzyl Alcohol				10	
1,2-Dichlorobenzene				10	
2-Methylphenol				10	
bis(2-Chloroisopropyl)ether				10	
4-Methylphenol				10	
n-Nitroso-di-n-dipropylamine				10	
Hexachloroethane				10	
Nitrobenzene				10	
Isophorone				10	
2-Nitrophenol				10	
2,4-Dimethylphenol				50	
Benzoic Acid				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL ($\mu\text{g}/\text{kg}$)	Methodology
<u>TCL Semivolatile Compounds</u> <u>(Continued)</u>	G, Teflon-lined cap 1, 8-oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW'/OLM 01.8
bis(2-Chloroethoxy)methane				10	
2,4-Dichlorophenol				10	
1,2,4-Trichlorobenzene				10	
Naphthalene				10	
4-Chloroaniline				10	
Hexachlorobutadiene				10	
4,-Chloro-3-methylphenol (para-chloro-meta-cresol)				10	
2-Methylnaphthalene				10	
Hexachlorocyclopentadiene				10	
2,4,6-Trichlorophenol				10	
2,4,5-Trichlorophenol				50	
2-Chloronaphthalene				10	
2-Nitroaniline				50	
Dimethylphthalate				10	
Acenaphthylene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/kg)	Methodology
<u>TCL Semivolatile Compounds</u> (Continued)	G, Teflon-lined cap 1, 8-oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
2,6-Dinitrotoluene				10	
3-Nitroaniline				50	
Acenaphthene				10	
2,4-Dinitrophenol				50	
4-Nitrophenol				50	
Dibenzofuran				10	
Diethylphthalate				10	
4-Chlorophenyl-phenyl ether				10	
Fluorene				10	
4-Nitroaniline				50	
4,6-Dinitro-2-methylphenol				50	
n-Nitrosodiphenylamine				10	
4-Bromophenyl-phenyl ether				10	
Hexachlorobenzene				10	
Pentachlorophenol				50	
Phenanthrene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/kg)	Methodology
<u>TCL Semivolatile Compounds</u> <u>(Continued)</u>	G, Teflon-lined cap 1, 8-oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
Anthracene				10	
Di-n-butylphthalate				10	
Fluoranthene				10	
Pyrene				10	
Butylbenzylphthalate				10	
3,3'-Dichlorobenzidine				20	
Benzo(a)anthracene				10	
Chrysene				10	
bis(2-Ethylhexyl)phthalate				10	
Di-n-octylphthalate				10	
Benzo(b)fluoranthene				10	
Benzo(k)fluoranthene				10	
Benzo(a)pyrene				10	
Indeno(1,2,3-cd)pyrene				10	
Dibenz(a,h)anthracene				10	
Benzo(g,h,i)perylene				10	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (µg/kg)	Methodology
<u>TCL Pesticides/PCBs</u>	G, Teflon-lined cap 1, 8-oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW'/OLM 01.8
alpha-BBC				0.05	
beta-BHC				0.05	
delta-BHC				0.05	
gamma-Bhc (lindane)				0.05	
Heptachlor				0.05	
Aldrin				0.05	
Heptachlor Epoxide				0.05	
Endosulfan I				0.05	
Dieldrin				0.10	
4,4'-DDE				0.10	
Endrin				0.10	
Endosulfan II				0.10	
4,4'-DDD				0.10	
Endosulfan Sulfate				0.10	
4,4'-DDT				0.10	
Methoxychlor				0.5	
Endrin Ketone				0.10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
 REQUIREMENTS
 RFI WORK PLAN
 NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL ($\mu\text{g/kg}$)	Methodology
<u>TCL Pesticides/PCBs</u> (Continued)	G, Teflon-lined cap 1, 8 oz. jar	Cool, 4°C	7 days from collection to extraction, 40 days after extraction		CLP SOW ¹ /OLM 01.8
alpha-Chlordane				0.5	
gamma-Chlordane				0.5	
Toxaphene				1.0	
Aroclor-1016				0.5	
Aroclor-1221				0.5	
Aroclor-1232				0.5	
Aroclor-1242				0.5	
Aroclor-1248				0.5	
Aroclor-1254				1.0	
Aroclor-1260				1.0	

TABLE 3-1
CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (mg/kg)	Methodology
<u>TAL Metals and Cyanide</u>	G; one 8-oz glass jar	Cool, 4°C	180 days		CLP SOW ¹ /ILM 02.1
Aluminum				40	
Antimony				12	
Arsenic				2	
Barium				40	
Beryllium				1 ²	
Cadmium				1	
Calcium				1,000	
Chromium				2	
Cobalt				10	
Copper				5	
Iron				20	
Lead				0.6	
Magnesium				1,000	
Manganese				3	
Mercury			28 days	0.2	
Nickel				8	
Potassium				1,000	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT
 REQUIREMENTS
 RFI WORK PLAN
 NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL (mg/kg)	Methodology
<u>TAL Metals and Cyanide</u> (Continued)	G; one 8-oz glass jar	Cool, 4°C	180 days		CLP SOW ¹ /ILM 02.1
Selenium				1	
Silver				2	
Sodium				1,000	
Thallium				2	
Vanadium				10	
Zinc				4	
Cyanide			14 days	10	

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

B. Soils, Solid Waste, and Sediment Samples					
Parameter	Container	Preservative	Holding Time	CRDL	Methodology
Additional Analytes					
pH (except sediment)	G; one 8-oz jar	Cool, 4°C	14 days	NA	SW 846-9045
Total Organic Carbon (except sediment)	G; one 8-oz jar	Cool, 4°C	28 days	10 mg/kg	MSA 29.3.5.2
Bulk Density (except sediment)	G; one 32 oz jar	None	None	NA	MSA Ch. 13
Grain Size (except sediment)	G; one 32 oz jar	None	None	NA	ASTM D422-63
Moisture Content (except sediment)	G; one 32 oz jar	None	None	NA	ASTM D2216-80
Permeability	Shelby Tube	NA	NA	NA	SW 9100
BTU	G; 8-oz jar	Cool 4°C	28 days	NA	ASTM D3286
TCLP	G; 2, 32-oz jars	Cool 4°C	14 days from collection to TCLP Extraction	As per CRQL/CRDL Aqueous	40 CFR 261/CLP SOW ¹
Total Petroleum Hydrocarbons	G; one 8-oz jar	Cool 4°C	28 days	NA	SW 846 9071 EPA 418.1
Chromium VI	P, G; one 8-oz jar	Cool 4°C	24 hours	NA	SW 7195
Ignitability	G; one 8-oz jar	Cool 4°C	NA	NA	SW 1010
Corrosivity	G; one 8-oz jar	Cool 4°C	NA	NA	SW 9045
Reactivity	G; one 8-oz jar	Cool 4°C	NA	NA	CN-EPA 335.2 Sulfide - EPA 376.2
Organic Lead	G; one 8-oz jar	Cool 4°C	180 days	NA	MSA - Chapter 21

TABLE 3-1

CONTAINER, AMOUNT, PRESERVATION, HOLDING TIME, AND CONTRACT-REQUIRED QUANTITATION LIMIT REQUIREMENTS

RFI WORK PLAN

NWIRP CALVERTON, LONG ISLAND, NEW YORK

- 1) - Contract Laboratory Program Statement of Work - CRQL's and CRDL's presented are for 1990 SOW. CRQL's and CRDL's will vary with dilution factor and sample percent solids.
- 2) - The NYSDEC soil action level for beryllium is 0.16 mg/kg.

NA - Not applicable

CRDL - Contract Required Detection Limits

CRQL - Contract Required Quantitation Limits

P - Polyethylene

G - Glass

TABLE 3-2

**RCRA HAZARDOUS WASTE PARAMETERS AND CRITERIA
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

PARAMETER	LIMIT (mg/l)
Silver	5.0
Arsenic	5.0
Barium	100
Cadmium	1.0
Chromium	5.0
Mercury	0.2
Lead	5.0
Selenium	1.0
Benzene	0.5
Carbon Tetrachloride	0.5
Chlorobenzene	100
Chloroform	6.0
1,4-Dichlorobenzene	7.5
1,2-Dichloroethane	0.5
1,1-Dichloroethene	0.7
Methyl Ethyl Ketone	200
Tetrachloroethene	0.7
Trichloroethene	0.5
Vinyl Chloride	0.2
o-Cresol	200
m-Cresol	200
p-Cresol	200
2,4-Dinitrotoluene	0.13
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Nitrobenzene	2.0
Pentachlorophenol	100
Pyridine	5.0

TABLE 3-2
RCRA HAZARDOUS WASTE PARAMETERS AND CRITERIA
RFI WORK PLAN
NWIRP, CALVERTON, LONG ISLAND, NEW YORK

PARAMETER	LIMIT (mg/l)
2,4,5-Trichlorophenol	400
2,4,6-Trichlorophenol	2.0
Chlordane	0.03
Cresol	200
2,4-D	10.0
Endrin	0.02
Heptachlor	0.008
Lindane	0.4
Methoxychlor	10.0
2,4,5-TP (Silvex)	1.0
Toxaphene	0.5

3.4 PARCC PARAMETERS

The quality of the data set is measured by certain characteristics of the data, namely the PARCC (precision, accuracy, representativeness, comparability, and completeness) parameters. Some of the parameters are expressed quantitatively, while others are expressed qualitatively. The objectives of the RFI and the intended use of the data define the PARCC goals.

3.4.1 Precision

Precision characterizes the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for a sample under the same or similar conditions. Precision is expressed as a range (the difference between two measurements of the same parameter) or as a relative percent difference (the range relative to the mean, expressed as a percent). Range and Relative Percent Difference (RPD) values are calculated as follows:

$$\text{Range} = \text{OR} - \text{DR}$$

$$\text{RPD} = (\text{OR} - \text{DR}) / [(1/2)(\text{OR} + \text{DR})] \times 100\%$$

where: OR = original sample result
DR = duplicate sample result

The internal laboratory control limits for precision are three times the standard deviation of a series of RPD or range values. RPD values may be calculated for both laboratory and field duplicates, and can be compared to the control limits as a QA check. Laboratory duplicates will be analyzed at the rate required by the CLP. Field duplicates will be collected for 10 percent of all samples collected.

3.4.2 Accuracy

Accuracy is the comparison between experimental and known or calculated values expressed as a percent recovery (%R). Percent recoveries are derived from analysis of standards spiked into deionized water (standard recovery) or into actual samples (matrix spike or surrogate spike recovery). Recovery is calculated as follows:

$$\%R = E/T \times 100\%$$

where: E = experimental result
T = true value (theoretical result)

and

$$T = [(sample\ aliq.)(sample\ conc.) + (spike\ aliq.)(spike\ conc.)]/(sample\ aliq. + spike\ aliq.)$$

Control limits for accuracy are set at the mean plus or minus three times the standard deviation of a series of %R values. Organic %R values are set at the mean plus or minus two times the standard deviation. Accuracy for aqueous and solid samples will be evaluated by use of surrogate and matrix spikes at the CLP-required incidences. CLP acceptance criteria and corrective actions apply. Out-of-criteria results will be reviewed for data applicability as a part of data validation.

3.4.3 Representativeness

All data obtained should be representative of actual conditions at the sampling location. The work plan is designed so that the samples taken will present an accurate representation of actual site conditions. The rationale discussed in the work plan are designed to ensure this. All sampling activities will conform to the protocols given in Section 4.0 of this work plan. The use of CLP analytical protocols and data deliverables will ensure that analytical results and deliverables are representative, and both consistently performed and reported.

3.4.4 Comparability

Comparability will be achieved by utilizing standardized sampling and analysis methods and data reporting format. Both analytical procedures and sample collection techniques will maximize the comparability of this new data to previous data. Additionally, consideration will be given to seasonal conditions and other environmental conditions that could influence analytical results.

3.4.5 Completeness

Completeness is a measure of the amount of valid data obtained from the measurement program, compared to the total amount collected. For relatively clean, homogeneous matrices, 100-percent completeness is expected. However, as matrix complexity and heterogeneous increase, completeness may decrease. Where analysis is

precluded or where DQOs are compromised, effects on the overall investigation must be considered. Whether any particular sample is critical to the investigation will be evaluated in terms of the sample location, the parameter in question, the intended data use, and the risk associated with the error.

Critical data points may not be evaluated until all the analytical results are evaluated. If in the evaluation of results it becomes apparent that the data for a specific medium are of insufficient quality (95 percent), either with respect to the number of samples or an individual analysis, resampling of the deficient data points may be necessary.

3.5 FIELD BLANKS

To determine whether cross-contamination of samples has occurred, field blanks will be obtained. Field blanks will be taken at the rate of one per source per sampling event, and will be analyzed for TCL Volatiles, TAL metals, and/or cyanide in accordance with NEESA guidelines and depending on the sampling activities. In general, field blanks will be taken of water used for equipment decontamination purposes, once per week.

3.6 TRIP BLANKS

To determine whether contamination of samples or bottleware has occurred in the field, trip blanks will be used. Trip blanks consist of analyte-free water taken from the laboratory to the site, and returned. Trip blanks are taken at the rate of one per cooler of volatile organic samples and will be analyzed for TCL VOAs only.

3.7 RINSATE BLANKS

An equipment rinsate blank consists of the final analyte-free water rinse from equipment decontamination procedures. Rinsate blanks are collected at a frequency of 1 per day per media for each day of sampling. Rinsate blanks are collected for the same analytical parameters as the media which was sampled using the particular equipment. Rinsate blanks are analyzed every other day per media. If positive detections are obtained from a rinsate blank sample, all remaining rinsate blanks are also analyzed.

3.8 BOTTLEWARE

NEESA requires specific bottleware cleaning procedures. Precleaned bottles will be used at the NWIRP Calverton. The required certification will be provided.

4.0 FIELD SAMPLING PLAN

4.1 GENERAL SITE BACKGROUND

Halliburton NUS has been tasked to perform a Full RFI at the NWIRP Calverton for four sites. In 1986, an Initial Assessment Study (IAS) identified potentially contaminated sites at NWIRP Calverton (RGH, 1986). Based on the IAS, a Site Investigation (SI) was conducted for the NWIRP Calverton between July 1991 and April 1992 (Halliburton NUS, 1992). This SI evaluated environmental contamination at seven areas, confirming contamination at four of these areas. Further investigation of contamination at the four sites, recommended in the SI Report, is addressed in this Full RFI Work Plan. The four areas under consideration are:

Site 1 - Northeast Pond Disposal Area

Site 2 - Fire Training Area

Site 6A - Fuel Calibration Area

Site 7 - Fuel Depot

Contaminants detected at one or more of these sites include solvents, fuels, heavy metals, and PCBs/pesticides. The locations of the four areas are shown in Figure 1-3.

4.1.1 Site Location

The sites involved in this study are located within the confines of the Calverton Naval Weapons Industrial Reserve Plant (NWIRP) in Calverton, Suffolk County, New York, (see Figures 1-1 and 1-2). The majority of the facility is located within the municipality of Riverhead; a small area on the western side is located within Brookhaven. Calverton is located on Long Island approximately 80 miles east of New York City (USGS, 1967).

The coordinates of the individual sites to be investigated during the RFI at the Calverton NWIRP are as follows.

<u>Site</u>	<u>Latitude</u>	<u>Longitude</u>
Northeast Pond Disposal Area	40°55'30"N	72°46'59"W
Fire Training Area	40°54'26"N	72°48'07"W
Fuel Calibration Area	40°54'40"N	72°47'28"W
Fuel Depot Area	40°54'50"N	72°47'53"W

4.1.2 Site Layout

The Calverton facility is approximately 6,000 acres overall in area. The investigated section of the facility occupies approximately 3,000 acres and is dominated by two large runways (Figure 1-2). The facility is roughly rectangular in shape and measures, at its greatest distances, 3.65 miles east to west and 1.6 miles north to south (USGS, 1967).

The facility is bordered by Middle Country Road (NY Rt. 25) to the north, agricultural land to the east, River Road to the south, and Wading River Road to the west. The primary features of the facility are two large paved runways, a 7,000-foot runway (Runway 5-23) located on the western half of the site and oriented southwest to northeast, and a 10,000 foot runway (Runway 32-14), located on the eastern half of the site and oriented southeast to northwest. The runways are connected by a 1,250-foot taxiway at the north central section of the runways.

4.1.3 General Site History

The Calverton Facility has been owned by the United States Navy since the early 1950's. At that time, the property was purchased from a number of private owners. The facility was expanded in 1958 through additional purchases of privately owned land. Grumman Aerospace Corporation has operated the facility since its construction (Navy, 1986).

The Calverton NWIRP facility was constructed in the early 1950's for use in the development, assembly, testing, refitting, and retrofitting of Naval combat aircraft. Grumman Aerospace Corporation has been the sole operator of the facility, which is known as a Government-Owned-Contractor Operated (GOCO) installation. Construction was completed in 1954. The facility supports aircraft design and production at the Grumman Bethpage, New York NWIRP (Navy, 1986).

The majority of industrial activity at the facility is confined to the developed area in the center and south center of the facility, between the two runways. Industrial activities at the facility are related to the manufacture and assembly of aircraft and aircraft components. Hazardous waste generation at the facility is related to metal finishing processes, such as metal cleaning and electroplating. The painting of aircraft and components results in additional waste generation (MPC, 1990-1991; Navy, 1986).

4.1.4 Facility Physical Characteristics

4.1.4.1 Surface Water

The Calverton facility is located in an area underlain by permeable glacial material and characterized by limited surface water drainage features. Normal precipitation at the facility is expected to infiltrate rapidly into the soil.

The majority of the facility is located within the Peconic River drainage basin. Extensive wetland areas and glacially formed lakes and ponds are located southwest and south of the facility. The eastward-flowing Peconic River is located approximately 500 feet south of the facility at its closest point. Based on topography, groundwater is expected to flow southward and discharge to the ponds and wetland areas, and ultimately be received by the Peconic River via overland flow. The Peconic River flows 1.95 stream miles eastward from Runway 32-14 into Peconic Lake. The Peconic is tidally influenced below the dam on the Peconic Lake, located 3.2 stream miles from the site, and discharges to Peconic Bay which is 8.5 stream miles from the facility.

Major surface water features at the Calverton facility include McKay Lake, the northeast pond, and the north pond. McKay Lake is a groundwater recharge basin located north of River Road, midway along the southern site border. The northeast pond is located at the northeast corner of the site, and North Pond is located at the southwest corner of the facility. Several small drainage basins exist near the fuel calibration area. All of these ponds and drainage basins are land locked, with the exception of McKay Lake, which has an intermittent discharge to Swan Pond, located 1,500 feet to the south. Swan Pond, approximately 55 acres in size, discharges to the Peconic River 1.6 stream miles south of the McKay Lake via a string of cranberry bogs (USGS, 1967; Navy, 1986).

McKay Lake receives noncontact cooling water discharge from industrial activities at the site, treated sanitary effluent and storm water runoff from paved areas in the developed center of the site. The lake is approximately 9 acres in area, and is known to support fish such as large mouth bass and bluegills. An intermittent drainage pathway leads into the northwest corner of the lake from an origin approximately 2,000 feet to the northwest. The lake is not believed to receive direct surface water runoff from any of the areas involved in the site inspection (Navy, 1986, 1976; Guthrie, 1983, 1984).

The northeast pond area actually consists of two ponds, a 2.3-acre pond directly east of the disposal area and an approximately 1-acre pond located less than 500 feet to the southeast of the disposal area. Both of these ponds lie in land-locked depressions and may be of glacial origin. Observations made during soil boring drilling activities in the pond disposal area indicated that the main ponds elevation is similar to the local groundwater elevation. As stated earlier, no outfalls exist from the ponds; they are expected to receive limited overland surface water flow from surrounding land in the northeast corner of the site (USGS, 1967).

The North Pond, an approximately 1.75-acre, landlocked pond located approximately 1,000 feet southwest of the southwest corner of the western runway, may receive limited overland surface water runoff from areas west of the western runway. The picnic grounds disposal area is located approximately 1,500 feet north of the pond; however, because of limited topographic influence, it is not expected that overland flow will reach the pond from the disposal area. The North Pond is north of a string of 6 interconnected ponds leading to the Peconic River (although it is not connected to the ponds). These include Prestons Pond, an unnamed pond, Forest Pond, Linus Pond, Fox Pond, and Sandy Pond. All are less than 16 acres in size. Prestons Pond is located approximately 750 feet south of North Pond; the drainage from Prestons Pond reaches Peconic River, approximately 2.1 stream miles to the southeast.

The small drainage basins located near the fuel calibration area are land-locked and receive limited surface water runoff from immediately adjacent areas. Surface water runoff from the fuel calibration area is collected by drainage ditches paralleling the southern and eastern edges of the paved area. The ditches enter a southward-flowing culvert at the southeast corner of the calibration area; the culvert ends approximately 250 feet west of the engine test house, south of the road. A drainage ditch flows southward 500 feet from the outfall and enters a depression containing two small ponds. These ponds are located approximately 1,500 feet south of the fuel calibration area.

Surface water runoff from the remaining study areas (Sites 2 and 7) is expected to infiltrate into the soil. Runoff from the fire training area flows to the southeast; the nearest potential receiving water is Swan Pond, located 2,000 feet to the southeast. Runoff from the fuel depot flows eastward via a very shallow slope into woodlands. No direct drainage pathway to a surface water body exists. Runoff from the Runway 32-14 runup area is expected to flow southeastward into the shallow excavated area adjacent to the runup area. Surface water runoff for the area at the end on the Runway 32-14 is expected to flow approximately 500 feet south to the Peconic River. The elevation of the end of the runway is approximately 20 feet above the river in this area.

A long string of interconnected ponds exists approximately 3,500 feet west of the western edge of the Calverton Facility. These ponds, including Horn Pond, Peasys Pond, Duck Pond, Sandy Pond, Grassy Pond, and Jones Pond, begin immediately south of NY Rt. 25 and flow approximately 2.5 stream miles to the Peconic River. The ponds are all less than 20 acres in size. These water bodies may receive infiltrated runoff and limited surface water runoff from the far western areas of the facility.

A limited number of small wetland areas exist on the Calverton facility. North pond is classified by the U.S. Department of the Interior, Fish and Wildlife Department as a palustrine emergent wetland. The western half of the 2 acre northeast pond is classified as palustrine, forested/scrub/shrub wetland. The drainage basin receiving runoff from the fuel calibration area is classified as palustrine scrub/shrub/emergent wetland (U.S. Department of the Interior, 1980).

Extensive areas of wetlands exist south of the facility adjacent to the Peconic River and its tributaries, including Swan Pond. The dominant wetland classifications of these areas are palustrine forested, palustrine scrub/shrub, and palustrine emergent. Areas of lacustrine open water wetland exist along the Peconic River. Approximately 7 stream miles from the site, areas of estuarine intertidal wetlands begin, which continue along the Peconic River into Great Peconic Bay. Predominant classifications in the tidal areas include emergent, flat and beach/bar wetlands.

The total wetland frontage within the 15-mile surface water drainage pathway is greater than 15 miles (U.S. Department of the Interior, 1980).

4.1.4.2 Regional Geology

NWIRP Calverton lies within the Atlantic Coastal Plain Physiographic Province. Generally, this region can be characterized as an area of relatively undissected, low-lying plains. The Atlantic Coastal Plain is underlain by a thick sequence of unconsolidated deposits. The surface topography has been created or modified by Pleistocene glaciation (Isbister, 1966).

Ground surface elevations on Long Island range from sea level to approximately 400 feet above mean sea level (MSL). The two most prominent topographic features in the Long Island area are the Ronkonkoma terminal moraine and the Harbor Hill end moraine. These east-west trending highlands mark the southern terminus or maximum extent of two glacial advances. The older Harbor Hill moraine lies along the northern shore of Long Island, the younger Ronkonkoma moraine basically bisects the island. NWIRP Calverton occupies a relatively flat, intermorainal area between these two features. The topographic relief at NWIRP is 54 feet; elevations range from 30 to 84 feet above mean sea level (McClymonds and Franke, 1972; Jensen and Soren, 1974).

NWIRP Calverton is underlain by approximately 1,300 feet of unconsolidated sediments. The unconsolidated sediments consist of four distinct geologic units. These units, in descending order, are the Upper Glacial Formation, the Magothy Formation, the Raritan Clay Member of the Raritan Formation, and the Lloyd Sand Member of the Raritan Formation (McClymonds and Franke, 1972).

The glacial sediments beneath the NWIRP are approximately 250 feet thick and consist of both glacial till and outwash deposits. Till is deposited directly by the ice, while outwash deposits are laid down by meltwater-supplied glaciofluvial systems. The till in Suffolk County ranges from 0 to 150 feet in thickness and generally consists of poorly sorted to unstratified sediments. The outwash deposits consist chiefly of well-sorted and stratified sand and gravel. One important characteristic of outwash deposits is their high degree of heterogeneity. Lithologies may vary widely over relatively short vertical and horizontal distances.

The Cretaceous age Magothy Formation underlies the Upper Glacial Formation and is approximately 520 feet thick. The Magothy Formation chiefly consists of stratified, fine to coarse sand and gravel.

The Cretaceous age Raritan Clay Member of the Raritan Formation underlies the Magothy Formation and is approximately 170 feet thick. The Raritan Clay consists of clay and silty clay.

The Lloyd Sand Member of the Raritan Formation underlies the Raritan Clay and is approximately 400 feet thick. The Lloyd Sand consists chiefly of fine to coarse sand and gravel.

The unconsolidated sediments beneath the site unconformably overlie crystalline bedrock. The crystalline bedrock consist of schist, gneiss, and granite. The regional dip is to the south and southeast. All of the geologic units dip in these directions, although to varying degrees (McClymonds and Frank, 1972).

4.1.4.3 Facility-Specific Geology

A soil boring and sampling program was completed as part of the site investigation. This program consisted of drilling testing borings using hollow-stem auger and split-spoon sampling techniques through the vadose zone sediments to the top of the water table at various locations throughout the NWIRP. Because of the shallow depth to the water table beneath the activity, the depths of the borings range from 7 to 22 feet. Consequently, the Upper Glacial Formation was the only unit encountered/sampled.

The borings reveal that the sites are predominantly underlain by coarse to very coarse sediments of probable glaciofluvial origin. Two dominant lithologies were encountered. The upper lithofacies is a brownish to orange-brown coarse sand which contained varying but always minor amounts of clay and silt. Where present, these lithofacies typically extended from near the surface to a depth of approximately 4 to 5 feet. The upper zones of these lithofacies most likely grade into the lower soil horizons, but the cut-and-fill or disturbed nature of the sites made it difficult or impossible to identify soil zones. Underlying this sand is a highly uniform, light tan to buff colored, coarse to very coarse grained sand with infrequent gravel. The thickness of this facies is unknown, as no underlying facies were penetrated.

4.1.4.4 Soils

The soils underlying the NWIRP were discussed in detail in the IAS (Navy, 1986). Each site studied as part of this investigation occurs in an area that, by the nature of the site activity, involved the disturbance of the soil. It is unlikely that the native soil exists as mapped beneath any of the sites. This is due to fill activity (the picnic grounds

and the pond disposal area), soil removal activity (the fire training area), or the cut-and-fill or grading activity associated with construction at the other sites.

4.1.4.5 Hydrogeology

The unconsolidated sediments that underlie the NWIRP are generally coarse-grained with high porosities and permeabilities. These factors create aquifers with high yields and high transmissivities.

The Upper Glacial Formation, the Magothy Formation, and the Lloyd Sand are the major regional aquifers. The Upper Glacial and the Magothy aquifers are of principal importance in Suffolk County because of their proximity to the land surface. The Lloyd Sand is not widely exploited because of its depth (McClymonds and Franke, 1972).

The Upper Glacial aquifer is widely used as a source of ground water in Suffolk County. The water table beneath the NWIRP lies within this aquifer. Porosities in excess of 30 percent have been calculated for the Upper Glacial aquifer in the adjoining Nassau County, Long Island. The estimated value of hydraulic conductivity is 270 feet per day (ft/day).

The Magothy aquifer is widely used as a source of ground water in Suffolk County. The most productive units are the coarser sands and gravels. The permeability of the Magothy is high; hydraulic conductivities have been calculated in excess of 70 ft/day.

The Upper Glacial and the Magothy aquifers are believed to be hydraulically interconnected and to function as a single unconfined aquifer. Onsite well logs, previous hydrogeological investigations, and geologic mapping indicate that although clay lenses are present in both aquifers that may create locally confining and/or perched conditions, these lenses are not widespread and do not function as regional aquitards (McClymonds and Franke, 1972; Fetter, 1976).

The Raritan Clay has a very low permeability (approximately 3×10^{-5} ft/day) and hydrologically acts as a regional confining layer. The confining nature of this unit is believed to minimize the local risk of contamination to the underlying Lloyd Sand aquifer (McClymonds and Franke, 1972).

The Lloyd Sand is a potentially excellent aquifer that has not been extensively developed due to its depth and the abundant water available in the overlying aquifers. Estimated hydraulic conductivities for the Lloyd Sand range from 20 to 70 ft/day.

The depth to the water table beneath the activity, as determined by the soil boring program, ranges from approximately 5 feet beneath the Fuel Calibration area (Site 6A) to approximately 20 feet beneath the Pond Disposal area (Site 1). When surface elevations are taken into account, the relief of the water table over the entire activity is also approximately 15 feet. The hydraulic gradient beneath the activity, then, may be characterized as low.

Groundwater flow rates beneath the activity are not known. As discussed, the aquifers beneath the activity have high porosities and permeabilities and would support high groundwater velocities. Without a sufficient hydraulic gradient or "driving force," however, groundwater velocities will be low, regardless of the physical properties of the matrix. Monitoring wells will be installed, aquifer tests will be conducted to determine aquifer characteristics, and groundwater gradient and flow velocities will be investigated as part of the RFI.

The overall direction of groundwater flow beneath the NWIRP is uncertain. As discussed in the IAS, the NWIRP is situated very near a regional groundwater divide. The IAS hypothesized that the activity actually straddled this divide, with groundwater beneath the northern half of the activity flowing to the north and groundwater beneath the southern half of the activity flowing to the south. Examination of the topographic map, however, seems to indicate that the general slope of the surface and the surface drainage over the entire activity is predominantly to the south. Assuming that the configuration of the water table in an unconfined aquifer is similar to the surface topography, it appears that the flow of groundwater in the unconfined zone beneath the entire activity is generally to the south. Localized undulations or changes in topography at the individual sites may alter this flow direction, especially in the shallowest aquifer zones. The Peconic River basin is the likely discharge point for most of the groundwater in the shallow aquifer zones (Upper Glacial and upper Magothy aquifers). Although the vertical gradients beneath the NWIRP are not known, it seems likely that a portion of the groundwater beneath the activity may migrate downward and recharge the deeper zones of the Magothy, and thus enter the regional groundwater system (Navy, 1986).

Based on observations during the site investigation and well elevations reported by MPC, the groundwater flow directions beneath the individual sites are similar to those stated in the IAS. During the site investigation, the apparent groundwater flow direction at the fire training area is to the southeast and the groundwater flow direction at both the fuel calibration area and the fuel depot area is to the east. The IAS was based on a larger set of monitoring wells and indicated local groundwater flows directions of southwest, southeast, and southeast, respectively (MPC, 1991).

The facility production wells undoubtedly affect the flow pattern of the local groundwater, but to an unknown extent. These wells are between 140 and 155 feet deep. The individual well draw down and the radius of the resultant cone of depression formed by the pumping of these wells are not known (Fetter, 1976; Sedburn, 1970a and b).

4.1.4.6 Climate and Meteorology

The facility is located in an area classified as a humid-continental climate. Its proximity to the Atlantic Ocean and Long Island Sound add maritime influences to this classification (National Oceanic and Atmospheric Administration, 1982).

The average yearly temperature at the NOAA Riverhead Research Station, located 4.5 miles northeast of the site, is 52.2 F, with a mean maximum average monthly temperature of 73.3 F in July and a minimum average monthly mean temperature of 30.9 F in January. Annual precipitation at the Riverhead station averages 45.32 inches. The highest month average precipitation is 4.46 inches, occurring in December, and the lowest 2.90 inches, occurring in July. The average yearly evapotranspiration rate is 29 inches, resulting in a net annual precipitation rate of 16.32 inches. A 2-year, 24-hour rainfall can be expected to bring 3.4 inches of precipitation (National Oceanic and Atmospheric Administration, 1982; U.S. Department of Commerce, 1961).

4.1.4.7 Surrounding Land Use

The land surrounding the Calverton facility in all directions is primarily agricultural or wooded, with scattered residences and commercial establishments. Wildwood State Park and Long Island Sound are located 2.3 miles and 2.75 miles north, respectively. The town of Riverhead is located 4.25 miles to the east. A golf course, Swan Pond, and a large area of swamp, wetland, and cranberry bogs are located immediately south of the facility. The Long Island Railroad passes within 1,000 feet of the southeast corner of the facility. Brookhaven National Laboratory is located 2 miles southwest of the facility. A residential development surrounding Lake Panamoka is located 1 mile west of the facility (USGS, 1967).

4.1.4.8 Population Distribution

The population residing within a 4-mile radius of the facility is as follows:

<u>Distance</u>	<u>Population</u>
0-1/4 mile	18
1/4-1/2	137
1/2-1	359
1-2	1,827
2-3	2,654
3-4	4,058

This figure was obtained using a house count taken from United States Geologic Survey (USGS) topographic quadrangles multiplied by 3.04 persons per household, the 1990 U.S. Census household population figure for Suffolk County. Additionally, it should be noted that 2,800 workers are present daily on site at the Calverton facility. The workers (3,000) and resident population (609) at the Brookhaven National Laboratory are not included in this figure. Only a small portion of the laboratory falls within a 4-mile radius of the site (USGS, 1967; Navy, 1986; DOE, 1990; U.S. Department of Commerce, 1990).

4.1.4.9 Critical Environments

According to the U.S. Department of the Interior, Fish and Wildlife Service, no federally listed endangered or threatened species reside within a 4-mile radius of the study area. Transient individuals of endangered species, such as the Bald Eagle (*Haliaeetus leucocephalus*), may occur within the study area (Corin, 1991).

Information provided by NYSDEC and the New York Natural Heritage program indicated that several New York State endangered and threatened animal species exist within the study area. The most notable, tiger salamander (*Ambystoma tigrinum*), may occur on site in the ponds adjacent to the fuel calibration area, and possibly the northeast pond. Other species include the northern cricket frog (*Acris crepitans*) and the least tern (*Sterna Antillarum*). Numerous additional endangered and threatened plant species occur within the study area, (Buffington, 1991; Scheibel, 1991).

According to the information supplied by NYSDEC, the wetland areas surrounding the Peconic River, including Swan Pond, are the location of significant habitat for many endangered and threatened animals and plants (Buffington, 1991; Scheibel, 1991).

4.1.4.10 Water Supply

Groundwater serves as the source of drinking water for the population residing within a 4-mile radius of the site. Private wells, wells on two government-owned facilities (Grumman Aerospace Corporation [Calverton NWIRP] and Brookhaven National Lab), and three municipal water systems (Riverhead Water District, Shorewood Water Company, and Suffolk Water Company) supply the drinking water needs of the study area. The location of these wells is provided in Plate 1 of the SI Report. Calculations supporting the apportioned populations serving each of these wells is also provided in the SI Report.

Private Wells

The nearest private wells to the facility are located 0.3 miles south, 0.7 miles east, 0.25 miles north, and 0.25 miles west of the facility; no information is available regarding construction details on these wells. Private home wells are the sole source of supply to residents southeast, south, and southwest of the Calverton facility. Concentrated housing developments to the west and northwest, including the areas of Ridge and Lake Panamoka, respectively, are currently served by home wells but will soon have access to public water supplies. Similarly, residences in areas north of the facility are not currently connected with municipal water but will soon have access to public water supplies (USGS, 1967; Pendzick, 1991; Anderson, 1991).

In addition to the private home wells, Grumman as a private company, owns two wells within 0.1 miles south of the plant near the main gate. The following information is available regarding the Grumman wells.

<u>Plant No.</u>	<u>Depth (feet)</u>	<u>Capacity (GPM)</u>
8	147	79
78	151	79

Even though these two well are classified as private wells, because of the relationship between Grumman and the NWIRP, the apportioned population served by these wells is considered with the onsite production wells. Analytical testing of these wells did not reveal the presence of contamination.

Government-Owned Facilities

The Calverton NWIRP and Brookhaven National Labs are the only two government-owned facilities within a four-mile radius of the site (USGS, 1967).

The Calverton NWIRP serves approximately 2,800 workers with potable water from three production wells. The wells are located in a line approximately 2,500 to 2,750 feet north of the south gate, approximately 500 feet west of the roadway (see Figure 2-2) (USGS, 1967; Navy 1986). The following information is available regarding onsite production wells:

<u>Well No.</u>	<u>Depth (feet)</u>	<u>Capacity (gpm)</u>
1	146	1,000
2	140	1,100
3	147	1,000

The three wells are completed in the upper glacial aquifer. Well No. 2 was removed from service on December 5, 1989 and Well No. 3 was removed from service on April 23, 1991 because of volatile organic contamination (Navy 1986 and Smith, 1991). The volatile organic chemicals detected at 2 ug/l or greater and the maximum concentration detected in samples collected by the county in March and April 1991 are summarized as follows (Suffolk County Department of Health Services, 1991).

Compound	Maximum Conc. Detected (ug/l)	Federal MCL (ug/l)	State MCL (ug/l)
1,1,1-trichloroethane	3	200	5
freon 113	14	No standard	5
vinyl chloride	2	2	2
(cis) 1,2-dichloroethene	2	70	5
1,1-dichloroethane	4	No standard	5

Historically, higher concentrations of 1,1,1-Trichloroethane (greater than 5 ug/l) have been detected in the production wells. Grumman is currently considering the addition of an air stripping tower to treat the production water prior to use.

The Brookhaven National Laboratory, located approximately 2 miles southwest of the Calverton facility, serves 609 residents and more than 3,000 workers from 7 production wells located within the facility. Four of these potable water wells, Nos. 5, 10, 11, and 12, are located within a 4-mile radius of the site. The following information regarding these wells is available (DOE, 1990).

<u>Well Number</u>	<u>Screened Interval (feet bgs)</u>	<u>Capacity (gpm)</u>	<u>Location</u>
4	95-147	1,200	4.5 miles SW
5	--	--	3 miles SW
6	98-150	1,200	4.6 miles SW
7	99-150	1,200	4.8 miles SW
10	91-140	1,200	3.6 miles SW
11	93-142	1,200	3.55 miles SW
12	92-137	1,200	3.5 miles SW

Wells 10 and 11 were removed from service in 1989 because of contamination by 1,1,1-trichloroethane above the New York State Drinking Water Standard of 5 ug/l. Average 1,1,1-trichloroethane concentrations found in quarterly sampling conducted in 1989 on Wells 10 and 11 were 5.8 ug/l and 7.0 ug/l, respectively. An average concentration of 8.3 ug/l of 1,1,1-trichloroethane was found in samples collected from these wells in three consecutive weeks during November 1989. In 1991, only Wells 4, 6, 7, and 12 have been used for potable water supply. The apportioned population served by the system is 202 residents, and 996 workers. The apportioned population is determined by multiplying the total population served by the system by the percentage of total system pumpage volume provided by wells within the 4-mile radius. The most recent yearly system pumpage rates available were used in the calculation (DOE, 1990; Brookhaven National Laboratory, 1991).

Municipal Water Systems

The Riverhead Water District (RWD) and the Shorewood Water Company (SWC) are the only two municipal water suppliers with wells located within a 4-mile radius of the Calverton NWIRP.

The RWD serves 5,700 customers (22,500 residents) from nine groundwater wells. Two of these wells, Nos. 7-1 and 7-2, are located within a 4-mile radius of the site; the remaining wells in the system are located beyond the 4-mile radius. The depths, capacities, and locations of the wells are listed below (Pendzick, 1991a and b).

<u>Well Number</u>	<u>Depth (feet)</u>	<u>Capacity (gpm)</u>	<u>Location</u>
1	105	750	4.75 miles E
2	140	1,000	4.6 miles E
3	125	1,000	4.75 miles E
4-1	720	1,000	4.4 miles ENE

4-2	225	1,200	4.4 miles ENE
5-1	250	1,200	6.5 miles ENE
5-2	460	1,200	6.5 miles ENE
7-1	780	300	1.9 miles N
7-2	490	1,340	1.9 miles N

Wells 1, 2, 3, 4-2, and 5-1 are completed in the upper glacial deposits. Wells 4-1, 5-2, 7-1, and 7-2 are completed in the deeper Magothy Formation (Pendzick, 1991a; Riverhead Water District, 1990).

The apportioned population served by the RWD system from sources within a 4-mile radius of the facility is 2,096 (Pendzick, 1991a; Riverhead Water District, 1990).

The area served by the RWD system is primarily east and northeast of the Calverton facility, beginning at a radius approximately 2.5 miles from the site. The system serves the area between Sound Avenue, approximately 2 miles north of the facility, and Long Island Sound. The RWD service area ends at the Riverhead/Brookhaven town line approximately 3 miles northwest of the facility. RWD is currently expanding immediately north of the facility, north of Middle County Road (NY Rt. 25) (Pendzick, 1991a).

The Shorewood Water Company serves 5,243 customers (12,000 residents) from seven groundwater wells. Two of these wells, Nos. 4 and 5, are located within a 4-mile radius of the facility; the remaining wells are located beyond the 4-mile radius. The depths, capacities, and locations of the systems wells are shown below (Anderson, 1991).

<u>Well Number</u>	<u>Depth (feet)</u>	<u>Capacity (gpm)</u>	<u>Location</u>
1	186	325	4.95 miles NW
2	175	300	4.95 miles NW
3	212	500	5.6 miles NW
4	144	1,050	3.9 miles W
5	146	1,000	3.9 miles W
6	230	1,050	4.2 miles NW
7	384	1,390	4.2 miles NW

The Shorewood Water Company's wells are completed in the upper glacial aquifer. The apportioned population served by the system's wells within a 4-mile radius of the site is 2,763 residents (Anderson, 1991).

The area served by SWC is located in a radius beginning 3 miles west and northwest of the facility. The system serves the northern shoreline of Long Island, west of the Riverhead/Brookhaven town line, including the towns of Shoreham and Rocky Point. SWC has started an expansion into the existing development surrounding Lake Panamoka, located between 1 and 2 miles west of the facility. SWC also plans to expand into a developed area in Ridge located between 2 and 3 miles west of the facility, north of Brookhaven National Laboratory, south of Middle Country Road (NY Rt. 25), and west of William Floyd Parkway.

The Suffolk Water Company serves a small number of residents (70 homes) located approximately 3.5 miles west of the facility, to the southwest of the intersection of Middle County Road and William Floyd Parkway. Suffolk's wells are located greater than 4 miles from the facility.

Summary

The total number of residents supplied by sources of groundwater within the 4-mile radius of the facility is as follows:

<u>Distance</u>	<u>Description</u>	<u>Number of Residents</u>
0-1/4 mile	Calverton Wells	2,800
	Domestic Wells	18
1/4 - 1/2 mile	Domestic Wells	137
1/2-1 mile	Domestic Wells	359
1-2 mile	RWD Wells	2,096
	Domestic Wells	1,757
2-3 mile	Domestic Wells	982
3-4 mile	SWC Wells	2,763
	Brookhaven Lab. Wells	1,198
	Domestic Wells	465

4.1.5 SI Report - Summary of Chemical Data

As a follow-up to the U.S. Navy Initial Assessment Study performed in 1986, as well as additional findings since this time, seven sites were investigated at the NWIRP in Calverton, New York. These sites can be classified as either landfill-type sites or sites resulting from documented or suspected historic spills or leaks of fuels, oils, and/or

solvents. The following summary is a discussion of the findings of the SI as they pertain to the 4 sites under consideration in this RFI.

The northeast pond disposal area (Site 1) is a landfill-type site. There are no reports of hazardous material being disposed in this site. The sites considered because of documented or suspected spills or leaks are the fire training area (Site 2), the fuel calibration area (Site 6A), and the fuel depot area (Site 7). The presence of free floating products in monitoring wells installed at Sites 2, 6A, and 7, is a direct indication of historic spills or leaks.

The most significant contaminants detected in the soils at Site 1 include naphthalene (1,700J ug/kg), PAHs (182,500J ug/kg), cadmium (42.4 mg/kg), chromium (959 mg/kg), copper (1,320J mg/kg), lead (314J mg/kg), nickel (233 mg/kg), and zinc (2,380J mg/kg). Low concentrations of surface water and sediment contamination were also found. Groundwater has not, to date, been investigated at this site.

The most significant contaminants detected in the soils at Site 2 include chloroethane (230J ug/kg), tetrachloroethene (580 ug/kg), toluene (4,300 ug/kg), ethylbenzene (1,500 ug/kg), PAHs (31,310J ug/kg), aldrin (36 ug/kg), PCBs (8,500 ug/kg), and lead (41.6J mg/kg). The most significant contaminants detected in the groundwater at Site 2 include chloroethane (4,500 ug/l), 1,1-dichloroethane (1,700 ug/l), toluene (320 ug/l), 1,2-dichlorobenzene (74 ug/l), PCBs (7.9 ug/l), Cadmium (22.8 ug/l), chromium (80.3 ug/l), lead (73.8 ug/l), and zinc (1,290 ug/l).

The most significant contaminants detected in the soils at Site 6A include 1,1,1-trichloroethane (7,400J ug/kg), toluene (1,300J ug/kg), xylene (17,000J ug/kg), and lead (21.2J mg/kg). The most significant contaminants detected in the groundwater at Site 6A include chloroethane (2,600 ug/l), 1,1-dichloroethane (300 ug/l), 1,1,1-trichloroethane (23 ug/l), toluene (140 ug/l), and lead (1,740 ug/l). Minimal contamination was found in the sediments at this site.

Minimal contamination was found in the soils at Site 7. The most significant contaminant detected was PAHs (4,750J ug/kg). However more significant groundwater contamination was found. The groundwater contaminants include benzene (390 ug/l), toluene (540 ug/l), xylene (960 ug/l), and lead (692 ug/l).

4.2 SAMPLING OBJECTIVES

The objective of this study is to obtain environmental information at each site in order to:

- Delineate the nature and extent of contamination at each site.
- Evaluate potential risks to human health and/or the environment posed by the contaminants found at each site.
- Collect data necessary to conduct a Corrective Measures Study.

4.3 FIELD OPERATIONS

The four sites to be addressed under this work plan are:

Site 1 - Northeast Pond Disposal Area

Site 2 - Fire Training Area

Site 6A - Fuel Calibration Area

Site 7 - Fuel Depot

Table 4-1 is a summary table of the field activities to be conducted at each site. The site background, sampling rationale, and sampling activities are discussed on a site-by-site basis in subsections 4.4 through 4.7.

4.3.1 Mobilization/Demobilization

Following approval of the Work Plan, Halliburton NUS will prepare drilling specifications, obtain a drilling subcontractor, and begin mobilization activities. All field team members will review the Work Plan. In addition, a field team orientation meeting will be held to familiarize personnel with the scope of the field activities.

The Field Operations Leader (FOL) will coordinate the mobilization activities upon arrival at the facility. The FOL will also make any equipment purchases required to conduct the field investigation. The equipment required for the field activities will be loaded in Pittsburgh and driven to the site by the FOL and a technician/geologist. After field activities are completed, the FOL will demobilize the equipment and drive back to Pittsburgh.

4.3.2 Background Soil Samples

Six background soil samples will be collected during the RFI field activities. One to two samples per site (maximum 6 samples) will be collected from undisturbed portions of the sites, in areas away from known or suspected activities. These samples will be collected with a hand auger at a depth of 6 to 12 inches bgs and analyzed for TAL inorganics at a fixed base laboratory. Information from the 6 background surface soil samples collected during the RFA Sampling Visit (Halliburton NUS, 1992) will be used in conjunction with the 6 background samples collected as part of this investigation. The results of testing will be used to statistically develop site-specific background soil concentration action levels for TAL inorganics.

TABLE 4-1

**SITE-SPECIFIC SUMMARY OF FIELD ACTIVITIES FOR RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Activity	Site 1 Northeast Pond Disposal Area	Site 2 Fire Training Area	Site 6A Fuel Calibration Area	Site 7 Fuel Depot Area
Soil Gas Survey		X	X	X
Geophysical Survey		X		
Test Pit Excavation	X	X		
Subsurface Soil Borings ⁸	X	X	X	X
Temporary Wells/Field-based groundwater sampling and analysis		X	X	X
Monitoring Well Drilling and Installation	X	X	X	X
Surface Soil Sampling	X	X	X	
Surface Water/Sediment Sampling	X			
Waste Sampling	X	X		
Monitoring Well/Groundwater Sampling	X	X	X	X
Staff Gauges	X			
Water Level Measurement	X	X	X	X
Site Survey	X	X	X	X
Aquifer Testing	X	X	X	X

4.4 SITE 1 - NORTHEAST POND DISPOSAL AREA

4.4.1 Site Background

The northeast pond disposal area is located approximately 1,000 feet south of Middle County Road (NY Rt. 25) and 0.95 mile east of the north gate, (Figure 4-1). This site consists of a relatively flat, 2-acre, disposal/borrow area. The apparent disposal area measures approximately 400 feet by 200 feet and is oriented south-southwest to north-northeast. The top of the disposal area slopes gently from west-southwest to east followed by a steep 15- to 20-foot drop to the adjacent marsh/pond surface. The marsh/pond is a glacially formed pond and approximately 2.3 acres in size (Figure 4-1) (USGS, 1967; Navy, 1986).

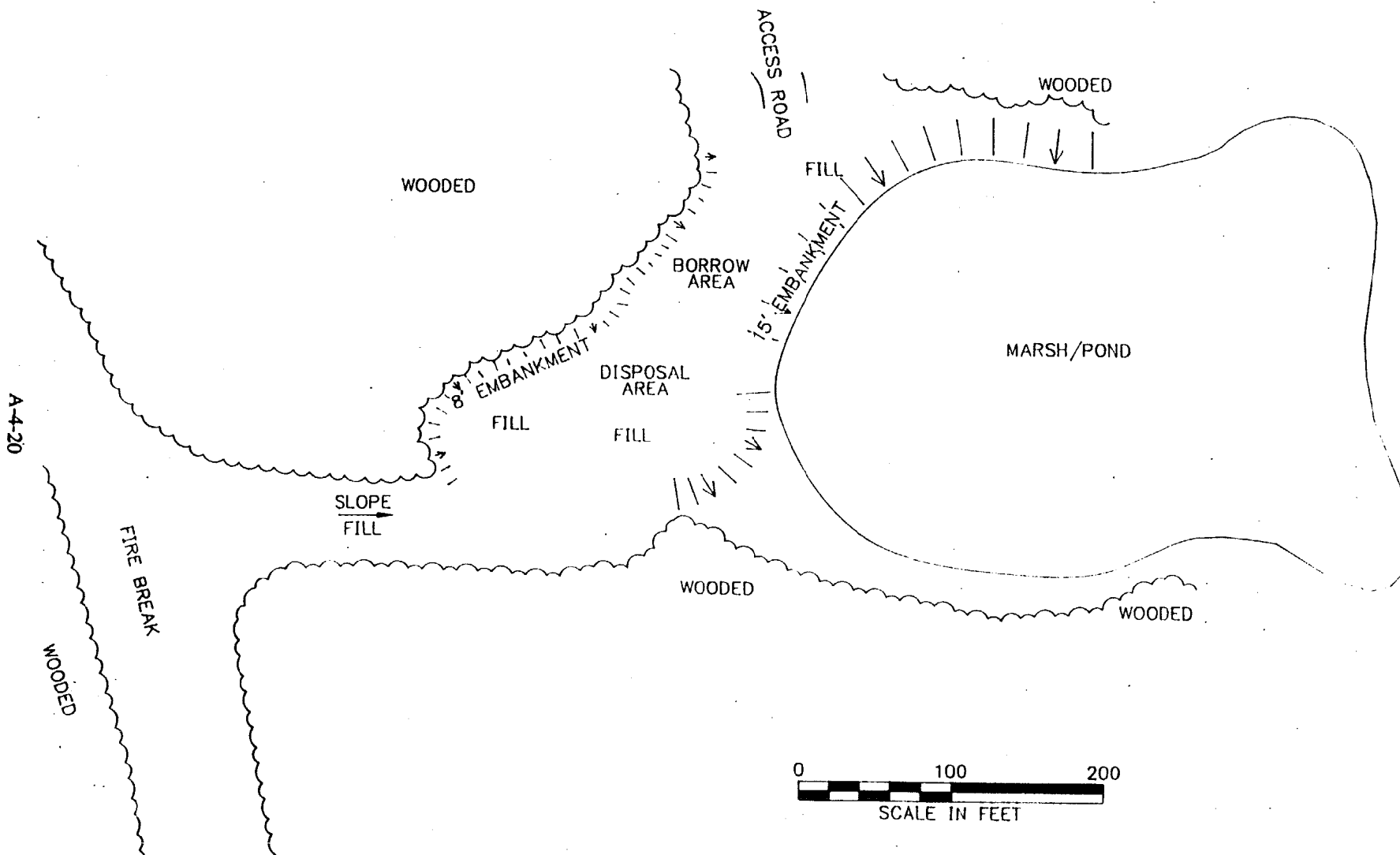
Waste materials were reportedly placed in the low areas near the pond's eastern edge. Fill material was then borrowed from the hillside located along the western and northern edges of the disposal area, creating an embankment of up to 8 feet in height in the hillside. The excavated material was used to cover wastes (USGS, 1967; Navy, 1986).

Currently, the majority of the disposal area is soil covered. A small area of exposed demolition debris exists on the embankment leading into the woods at the southern edge of the area (Navy, 1986).

The pond is approximately 2.3 acres in area and has no outlet. Based on the observed water levels in the soil borings, the surface water elevation approximates the local groundwater elevation. The center of the pond is covered by thick marsh growth, forming an island. The pond and the disposal area are completely surrounded by woodlands, with the exception of a long, thin, clearing leading westward from the southwest corner of the disposal area (USGS, 1967).

4.4.2 Specific Site History

Until 1984, the northeast pond disposal area was used primarily for the disposal of demolition debris such as concrete, brick, wood, and other construction materials. A final soil cover was placed over the disposed material in 1984. According to available information, other materials in the fill include aircraft sections and junked aircraft assembly tooling, office materials and furniture, pallets, and paint cans. The wreckage of several aircraft may be present in the area. Hazardous materials are not known to have been purposefully disposed of in the area.



SITE LAYOUT MAP
SITE 1 - NORTHEAST POND DISPOSAL AREA
NWIRP, CALVERTON, NY

FIGURE 4-1

However, it is reported in the 1986 Initial Assessment Study (IAS) that any of the following wastes may be present at the sites: petroleum, oils and lubricants (POLs), asphalt paving material, halogenated and nonhalogenated solvents, and paint sludges (Navy, 1986).

The waste materials were placed in a depression adjacent to the pond, and may have been used to fill portions of the pond. Soil borrowed from an adjacent hillside was used as cover material, creating a level area approximately 2 acres in size, with steep embankments up to 20 feet in height leading into the pond from the eastern edge of the disposal area (Navy, 1986).

No exposed wastes were observed on the surface or eastern embankment of the fill area during the site inspection. A small amount of debris, such as concrete chunks, wood scraps, and metal pieces, was exposed on the embankment leading into the woods from the south edge of the fill area. According to the IAS, approximately 7,500 cubic yards of material may have been disposed in this area.

4.4.3 Sampling Rationale

The Northeast Pond Disposal area is being investigated to fully delineate the nature and extent of contamination in soils, sediments, groundwater, and surface water at the site. The SI revealed soils, and surface water/sediment contamination (see Section 4.1.5). Groundwater was not investigated during the SI. Sampling activities for the RFI will focus on identifying the material in the disposal area, delineating the extent of soils contamination beneath the disposal area, and identifying impacts to the pond and to groundwater at the site.

4.4.4 Sampling Activities

The field investigation at Site 1 will consist of the following tasks:

- Test Pit Excavation and Subsurface Soil Sampling
- Subsurface Soil Borings and Subsurface Soil Sampling
- Surface Soil Sampling
- Surface Water Sampling
- Sediment Sampling
- Waste Sampling
- Permanent Monitoring Well Installation
- Groundwater Sampling - (permanent monitoring wells)
- Aquifer Testing

- Staff Gauge Installation
- Water Level Measurement
- Site Surveying

Soil, sediment, waste, groundwater, and surface water samples will be collected in accordance with NEESA methodology. Table 1-1 provides a summary of the chemical sampling program for the site. A summary list of all analytes, analytical methods, contract required quantitation limits, containers, preservatives, and holding times is provided in Table 3-1. A site specific summary of field activities, sampling, and sample analyses is presented in Table 4-2.

4.4.4.1 Test Pit Excavation and Subsurface Soil Sampling

Approximately 18 test pits will be excavated to delineate the nature and extent of fill material at the site. Test pit locations will be based on a grid pattern with 50-foot spacings (Figure 4-2). Test pits will be completed as per Halliburton NUS SOP GH-1.8. A backhoe will be used to excavate to the water table, maximum reach of the backhoe (approximately 10 feet), or the extent of fill material, whichever is reached first. Samples for chemical analysis will be collected directly from the backhoe bucket.

Zero to one (0-1) subsurface soil samples will be collected per test pit (Estimated 9 samples total). Samples will be screened using an organic vapor analyzer with sample testing biased toward elevated OVA readings. Samples will be collected from both the fill material and the underlying natural material (if encountered). Test pits will be backfilled to the surface upon completion of each test pit using the excavated material. A test pit log will be completed by the field geologist for each test pit. A blank test pit log form is included in Appendix B. Test pit locations will be marked with a wooden stake for future reference.

Soil samples collected from the test pits (approximately 9 samples plus 1 duplicate sample) (Table 4-2) will be submitted to a fixed base laboratory for the following chemical analyses:

All soil samples will be analyzed for PCB/pesticides and TAL inorganics.

TABLE 4-2

SITE 1 - NORTHEAST POND DISPOSAL AREA - FIELD ACTIVITIES
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK
(SEE TABLE 1-1 FOR ADDITIONAL DETAIL)

TASK	DESCRIPTION OF ACTIVITIES	ANALYSIS¹
Test Pit Excavation/Sampling	18 test pits excavated; 0-1 soil samples/test pit (avg. 0.5)	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ²
Subsurface Soil Boring/Sampling	5 subsurface soil borings; 2-3 samples/boring	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics
Surface Soil Sampling	6 surface soil samples	TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ²
Permanent Monitoring Well Installation/Groundwater Sampling	4 shallow depth monitoring wells installed; 2 rounds of groundwater samples	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, and engineering parameters ³
Surface Water Sampling	4 surface water locations; 1 sample/location	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, and engineering parameters ³
Sediment Sampling	8 sediment locations; 1-2 samples/location	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ² excluding BTU content and TCLP characterization
Waste Sampling	Up to 5 samples, if found, from test pits and/or soil borings	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, ignitability, corrosivity, reactivity, and other engineering parameters ²

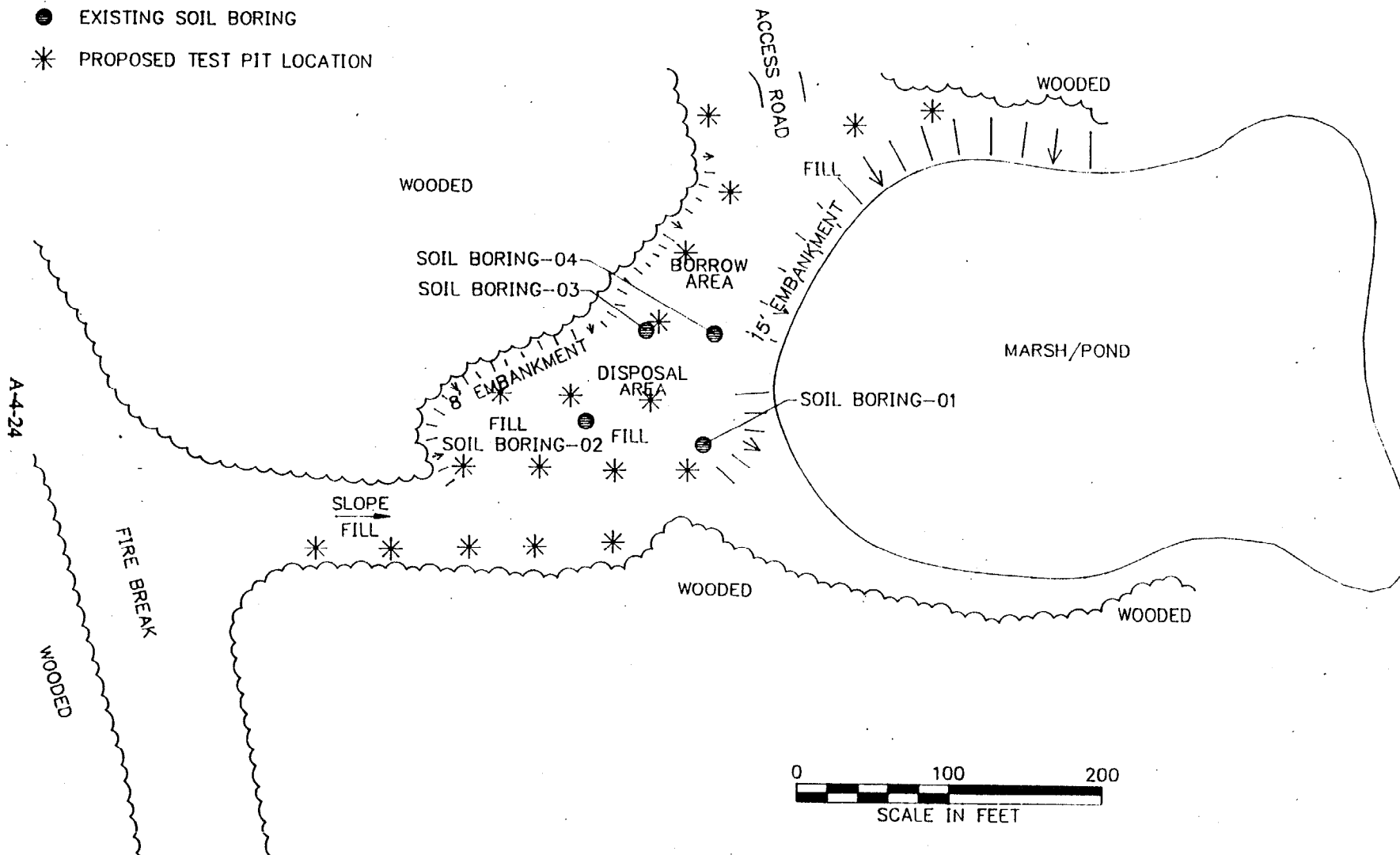
1 - See Table 1-1 for breakdown of analytes per sample.

2 - Engineering parameters include particle size, bulk density, moisture content, TOC, TPH, BTU content, and TCLP characterization.

3 - Engineering parameters include temperature, pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, and COD.

LEGEND

- EXISTING SOIL BORING
- * PROPOSED TEST PIT LOCATION



PROPOSED TEST PIT LOCATIONS
SITE 1 - NORTHEAST POND DISPOSAL AREA
NWIRP, CALVERTON, NY

FIGURE 4-2

Selected soil samples will be analyzed for TCL volatiles and TCL semivolatiles, based on elevated OVA readings and visual evidence of contamination. It is anticipated that approximately one sample from every two sampled test pit locations (5 samples: 4 samples plus 1 duplicate sample) will be submitted for TCL volatile and TCL semivolatile analysis.

Five soil samples (4 samples plus 1 duplicate sample) will also be analyzed for an additional suite of engineering parameters including: particle size, bulk density, moisture content, TOC, TPH, BTU content, and TCLP characterization. Two of these samples will be collected from the landfill material and two of these samples will be collected from the underlying natural material.

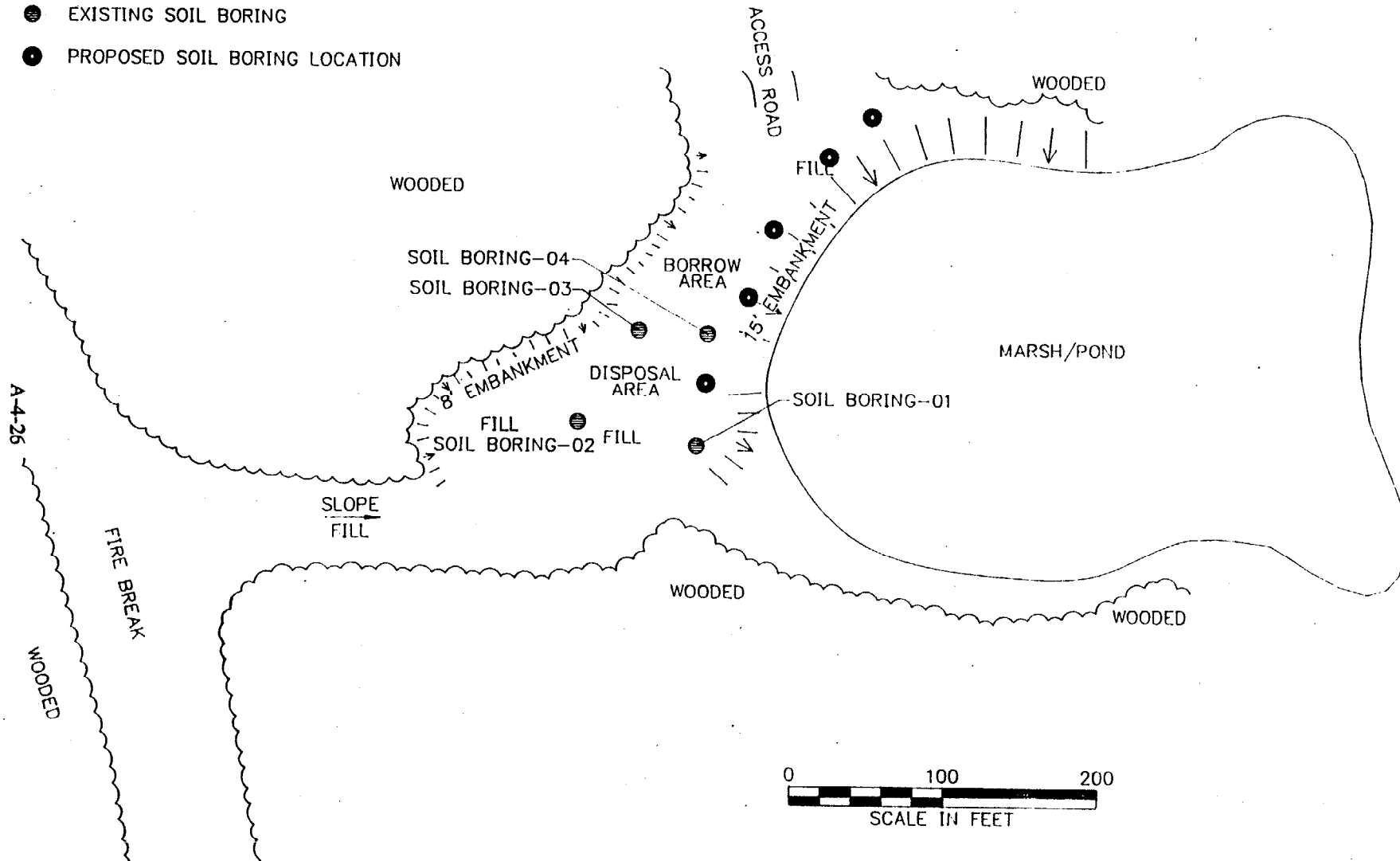
4.4.4.2 Soil Borings and Subsurface Soil Sampling

Five subsurface soil borings, spaced approximately 50 ft apart, will be drilled at 5 locations along the edge of the disposal area embankment (Figure 4-3). Fill material and the water table are expected to lie below the maximum reach of a backhoe (approximately 10 feet bgs) along the outer edges of the disposal area. The five borings will investigate the extent of fill material and the potential downward migration of contamination from the fill material into the underlying soils. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A).

Subsurface soil borings will be drilled to the water table (approximately 20 feet bgs) using hollow stem auger drilling techniques. During drilling operations, Standard Penetration Tests and split-spoon sampling for lithologic description will be performed continuously in all soil borings. All split-spoon samples will be screened with an Organic Vapor Analyzer (OVA) and visually inspected for lithologic description. Split spoon samplers will have a minimum outside diameter of 2 inches and be at least 2 feet long to fulfill the sample volume requirements for chemical analysis. Three inch diameter split spoons will be used to collect samples when extra volume is required (e.g. duplicate samples). The use of drilling fluids is prohibited during soil boring activities. Soil borings that are not converted to monitoring wells will be backfilled to the surface using drill cuttings. Cuttings from borings converted to monitoring wells will be screened with the OVA. Cuttings with visual evidence of contamination or OVA readings above background levels will be containerized onsite in 55-gallon drums. All drums will be stored at a centralized location at the facility. Otherwise, the cuttings will be spread at each site. Soil boring locations will be marked with a wooden stake for future reference.

LEGEND

- EXISTING SOIL BORING
- PROPOSED SOIL BORING LOCATION



PROPOSED SOIL BORING LOCATIONS
SITE 1 - NORTHEAST POND DISPOSAL AREA
NWIRP, CALVERTON, NY

FIGURE 4-3

A complete log of each boring will be maintained by the field geologist. Appendix B contains an example of the boring log form. At a minimum, the boring log will contain the following information, when applicable, for each overburden boring:

Sample numbers and types

Sample depths

Standard Penetration Test data

Sample recovery/sample interval

Soil density or cohesiveness

Soil color

Unified Soil Classification System (USCS) material description and symbol

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling method, and total depth of each borehole should be included on each boring log, as well as any other pertinent observations. Sample bottles containing soil samples collected solely for lithologic description will be numbered consecutively starting with S-1. In addition, the following information shall be recorded on the lid of the sample jars:

Job number and name

Boring and sample number

Date

Depth interval

Blow counts

As an alternative to obtaining samples with hollow stem augers, during the subcontractor procurement process, alternative sample collection techniques will be considered. One potential alternative is the "direct push" method of obtaining samples. Under this method, the samples are collected by hydraulically driving a 1-inch diameter piston-type sampler to the top of the desired sample interval; the piston within the sampler is released and the pipe advanced through the target interval. The soil core then enters the sampler, which contains a non-reactive plastic or stainless steel liner. After the drive rod is removed from the soil, the liner containing the soil column can be removed.

Two to three (2-3) samples will be collected for chemical analysis from each of the 5 borings (approximately 13 samples plus 2 duplicate samples)(Table 4-2). In each boring, one sample for chemical analysis will be collected from immediately above the soil/water interface. Additional samples for chemical analysis, from shallower depths in each boring, will be collected based on elevated OVA readings and visual observation of contamination (stained soils, etc...). Exact sampled intervals will be determined in the field.

Samples for chemical analysis will be collected by splitting the soil sample open longitudinally and extracting soil from the entire length of the interior of the sample. Portions of the sample submitted for TCL Volatiles analysis (when collected) will be placed directly into the required containers. Remaining portions of the sample will be homogenized and distributed to the appropriate containers. A stainless steel trowel will be used to place the sample into the required containers. Decontamination of drilling and sampling equipment will be performed as described in Section 4.11.

Soil samples collected from the subsurface soil borings will be submitted to a fixed base laboratory for chemical analysis as follows:

All soil samples will be analyzed for PCB/pesticides and TAL inorganics.

Selected soil samples will be analyzed for TCL volatiles and TCL semivolatiles, based on elevated OVA readings and visual evidence of contamination. It is anticipated that approximately one sample from every two borings (estimated 4 samples: 3 samples plus 1 duplicate sample) will be submitted for TCL volatile and TCL semivolatile analysis.

4.4.4.3 Surface Soil Sampling

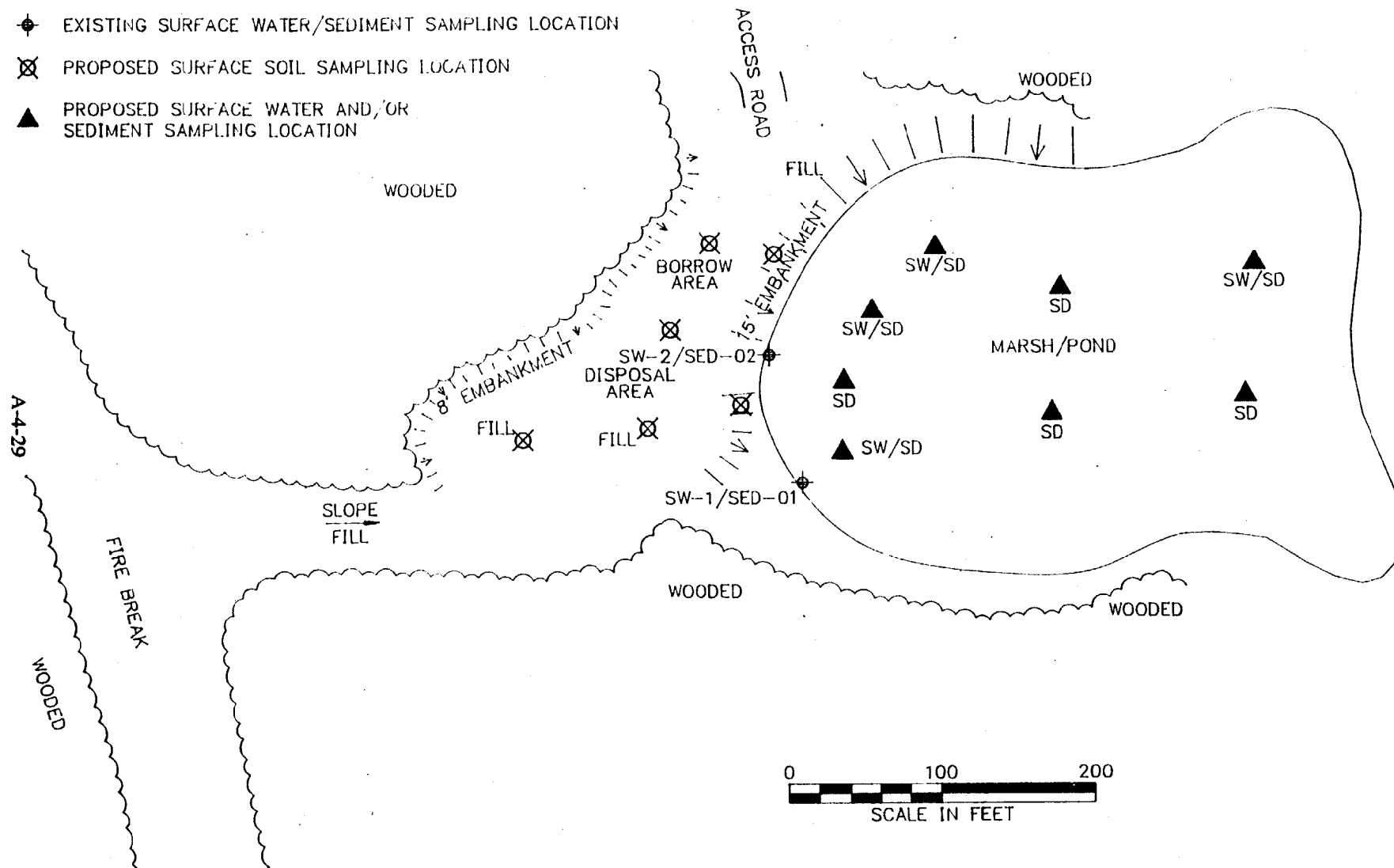
Seven surface soil samples (6 samples plus 1 duplicate sample) will be collected from 0-6 inches at 6 locations as follows (Figure 4-4, Table 4-2):

2 samples along the embankment face

4 samples on the upper surface of disposal area

LEGEND

- ◆ EXISTING SURFACE WATER/SEDIMENT SAMPLING LOCATION
- ⊗ PROPOSED SURFACE SOIL SAMPLING LOCATION
- ▲ PROPOSED SURFACE WATER AND/OR SEDIMENT SAMPLING LOCATION



PROPOSED SURFACE WATER, SEDIMENT, AND SURFACE SOIL SAMPLING LOCATIONS
SITE 1 - NORTHEAST POND DISPOSAL AREA
NWIRP, CALVERTON, NY

FIGURE 4-4

Surface soil samples will be collected using stainless steel trowels. The top several inches of soil will be removed before obtaining each sample. The grab samples will be placed directly into the required containers. Surface soil locations will be marked with a wooden stake for future reference. Decontamination of sampling equipment will be performed as described in Section 4.11. A blank sample log form is included in Appendix B.

Surface soils will be submitted to a fixed base laboratory for chemical analysis as follows:

All surface soil samples will be analyzed for TCL semivolatiles, PCB/pesticides, and TAL inorganics.

One surface soil sample will be selected by the field geologist to be analyzed for additional suite of engineering parameters including: particle size, bulk density, moisture content, TOC, TPH, BTU content, and TCLP characterization.

4.4.4.4 Surface Water/Sediment Sampling

Surface water/sediment samples will be collected from the pond (Figure 4-4, Table 4-2). Sample locations include:

- 1 location at the outflow of the drainage swale at the SW corner of pond
- 3 locations distributed near the disposal area embankment in the western portion of pond
- 2 locations in the central portion of the pond
- 2 locations in eastern portion of pond.

Five surface water samples (4 samples plus 1 duplicate sample) will be collected in accordance with Halliburton NUS SOP SA-1.2 (Appendix A). Surface water sampling locations are shown on Figure 4-4. The samples will be collected either by directly dipping the sample bottles into the water, or using a stainless steel beaker to transfer sample water to the required containers. Decontamination of sampling equipment, if used, will be conducted as described in Section 4.11.

In addition, field measurements will be obtained on the surface water samples after sample collection. Procedures for obtaining these field measurements are described in Halliburton NUS SOP SF-1.1 (Appendix A). These field measurements include:

- pH
- Specific Conductance
- Temperature

Relative color and turbidity will also be noted on the surface water sample log form. A blank sample log form is provided in Appendix B.

Fourteen sediment samples (12 samples plus 2 duplicate samples) will be collected in accordance with Halliburton NUS SOP SA-1.2 (Appendix A) after any surface water samples have been collected. Sediments will be collected from 0-6 inches at 8 locations. Sediment samples will also be collected from 6-12 inches at the 4 locations in the western half of the pond, adjacent to the disposal area. Material for VOA analysis will be transferred directly to the required container using a stainless steel trowel. The remaining sample material will be homogenized in a stainless steel bowl and transferred to the required containers. Decontamination of sampling equipment will be conducted as described in Section 4.11.

Surface water and sediment samples will be analyzed at a fixed base laboratory as follows:

All surface water samples will be analyzed for TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and hexavalent chromium.

One surface water sample will be analyzed for the following additional engineering parameters: temperature, pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, and COD.

All sediment samples will be analyzed for TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics.

One sediment samples will be analyzed for the following additional engineering parameters: particle size, bulk density, moisture content, TOC, and TPH.

4.4.4.5 Waste Sampling

Up to 5 discrete waste samples will be collected, if found, from test pits and/or soil borings. Samples will be collected in accordance with Halliburton NUS SOP GH-1.3 (Appendix A). Decontamination of sampling equipment will be conducted as described in Section 4.11.

Waste samples will be analyzed for the following waste characterization parameters: TCL volatiles, TCL semivolatiles, pesticides/PCBs, TAL inorganics, hexavalent chromium, TCLP characterization, Ignitability, Corrosivity, Reactivity, particle size, bulk density, moisture content, TOC, TPH, and BTU content.

4.4.4.6 Monitoring Well Installation

Four shallow depth (water table) monitoring wells will be drilled and installed at the site (Table 4-2).

1 shallow depth well will be located upgradient of the site, along the fire break.

3 shallow depth wells will be located in or adjacent to the disposal area. These shallow depth well locations will be based on the results of the soil boring and test pit activities.

Based on the results of groundwater analyses from these initial shallow depth wells, two intermediate depth (approximately 80 feet bgs) wells may be installed. Intermediate depth wells will be installed if groundwater in the shallow depth wells is contaminated. Intermediate depth wells will be paired with the furthest upgradient and furthest downgradient of the 3 shallow depth wells in the disposal area.

Monitoring well drilling and installation activities will be conducted as per Halliburton NUS SOP GH-1.3, GH-1.5, and GH-1.7. Boring logs will be completed as described in section 4.4.4.2.

Shallow depth well borings will be drilled using hollow stem auger drilling techniques. Split spoon samples for lithologic description will be collected continuously to the water table and every 5 ft below the water table to the total depth of the boring. Wherever practical, subsurface soil boring activities and shallow depth monitoring well installation will be combined (i.e. continue the soil boring into the water table and install a monitoring well). Except as described above, subsurface soil samples for chemical analysis will not be collected from monitoring well borings. In shallow depth wells, the top of the screened interval will be positioned approximately 2 feet above the depth that groundwater is encountered during drilling.

Intermediate depth wells, if installed, will be installed to approximately 80 ft bgs to help determine the vertical extent of groundwater contamination. These wells will be located approximately 10-20 ft from shallow depth wells to form shallow/intermediate depth well pairs. Intermediate depth well borings will also be advanced using hollow stem auger drilling techniques. If this method proves unsuccessful, alternative drilling techniques (mud rotary, and/or reverse circulation drilling) may be employed. Subsurface soil samples for chemical analysis will not be collected from intermediate depth monitoring well borings. Intermediate depth well borings will be geophysically logged (gamma-ray log) to the total depth of the boring and split spoon samples for lithologic description will be collected every 10 ft.

After the monitoring well borings are drilled to the desired depth (8-inch minimum diameter boring), the well screen and riser pipe will be installed through the augers (if used) to the desired depth. The annulus of the boring around the well screen, and 2 to 3 feet above the well screen, will be backfilled with clean silica sand (No. 20 to 30 U.S. Standard Sieve size or as determined by the site geologist). A bentonite pellet, or equivalent, seal (minimum 2-foot thickness) will then be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. The remainder of the boring annulus, from the seal to the ground surface, will then be backfilled with cement/bentonite grout using a tremie pipe. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted tape measure. A monitoring well construction form will be completed for each well. A sample well construction form is included in Appendix B.

All monitoring wells will be constructed of 4-inch I.D. PVC flush-joint riser pipe and flush-joint factory slotted well screen. Well screen slots shall be no larger than 0.02 inches. All well screens will be 10 feet in length. A schematic diagram showing typical well construction details is included in Appendix A.

A 6- to 8-inch diameter protective steel casing equipped with a locking steel cap will be installed around each well. These casings will be grouted a minimum of three feet into the ground and will have at least one drain hole positioned approximately 0.5 feet above the ground surface. A 0.5-foot thick concrete apron measuring 3 feet by 3 feet and equipped with 3 steel barrier posts will be constructed equally portioned around the casing of each well. All monitoring well locks will be keyed alike.

The monitoring wells will be developed after installation to remove fine material and sediments from the area around the well screens and to remove drill cuttings and residual fluids from the area around the monitored interval of the boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist. Wells will be developed until water removed is visibly clear of suspended solids or until approved by the field geologist. Wells will not be developed until a minimum of 24 hours has elapsed after installation of the cement/bentonite grout.

4.4.4.7 Groundwater Sampling

Groundwater samples (estimated 4 samples plus 1 duplicate sample) will be collected from all new monitoring wells at the site (Table 4-2). Two sampling rounds will be performed; one round during the wet season (March to May) and one round during the dry season (August to October). Groundwater sampling will be conducted in accordance with Halliburton NUS SOP SA-1.1. Prior to obtaining samples, water levels will be measured and the wells will be evaluated using an interface probe for the detection of immiscible phase liquids. Each monitoring well will be purged using a dedicated stainless steel bailer or a non-dedicated suction pump and disposable polyethylene tubing.

Three to six well volumes will be purged. Field measurements of pH, temperature, and specific conductance will be taken for each well volume during purging according to NUS SOP SF-1.1: Section 5. Stabilization of the above parameters is defined as follows: temperature $\pm 1^{\circ}\text{C}$, pH ± 0.2 units, SC ± 5 percent. If these parameters do not stabilize after 3 volumes, up to 6 volumes may be removed, as determined by the field geologist. If the wells are purged dry with fewer than three well volumes removed, the wells will be sampled when the water level in the well recovers to at least 70% of the original capacity, or within 24-hours of purging, whichever is first. The exception to this will be samples to be analyzed for volatile organics. Samples for volatile organics will be collected within 3 hours from the time of well purging.

Dedicated stainless steel bailers with dedicated polypropylene rope as bailing line will be used for sample collection.

All pertinent field data shall be recorded on the appropriate sample log sheet (Appendix B) and in the field log book. Groundwater samples will be analyzed as follows:

All groundwater samples will be analyzed for TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and hexavalent chromium.

The groundwater sample from the furthest downgradient shallow depth well will also be analyzed for the following engineer parameters: pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, and COD.

4.4.4.8 Aquifer Testing

A slug test will be performed on one shallow depth well, and one intermediate depth well (if installed) to determine the hydraulic characteristics of the alluvial aquifer at the site. Both rising head and falling head tests will be performed by either inserting a solid slug into the well to raise water levels, then measuring the rate of decline in water level (recovery), or by removing a slug of water and measuring the rate of rise of water level back to equilibrium. Slug test data will be collected using an Insitu Hermit data logger with transducer, an Insitu Levelhead with transducer, and/or an electronic water level indicator (M-scope). Results of the slug tests will be used to calculate values of hydraulic conductivity.

4.4.4.9 Staff Gauge Installation

One staff gauge will be installed in the pond to measure the pond elevation and study the interaction between groundwater and surface water at the site. The staff gauge will consist of a permanent wooden or steel rod driven

approximately 3 feet into the material underlying the pond. The vertical and horizontal position of a marked reference point on the staff gauge will be surveyed. The elevation of the surface of the pond will be measured from the marked reference point. Surface water and groundwater elevation data will be used to determine if the surface water is recharging groundwater or if the groundwater is discharging to the surface water.

4.4.4.10 Water Level Measurement

Two complete rounds of water levels will be collected from the new monitoring wells and the staff gauge. Each round of measurements will be taken within a 2-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements will be taken with an electronic water level indicator using a marked or notched location at the top of the PVC well casing as the reference point for determining depths to water. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate field logbook and on water level measurement forms (attached in Appendix B).

4.4.4.11 Site Surveying

The vertical and horizontal location of all monitoring wells, staff gauges, test pits, subsurface soil borings, and surface soil sampling points will be surveyed upon completion of field activities. Surface water/sediment sampling points will be approximately located.

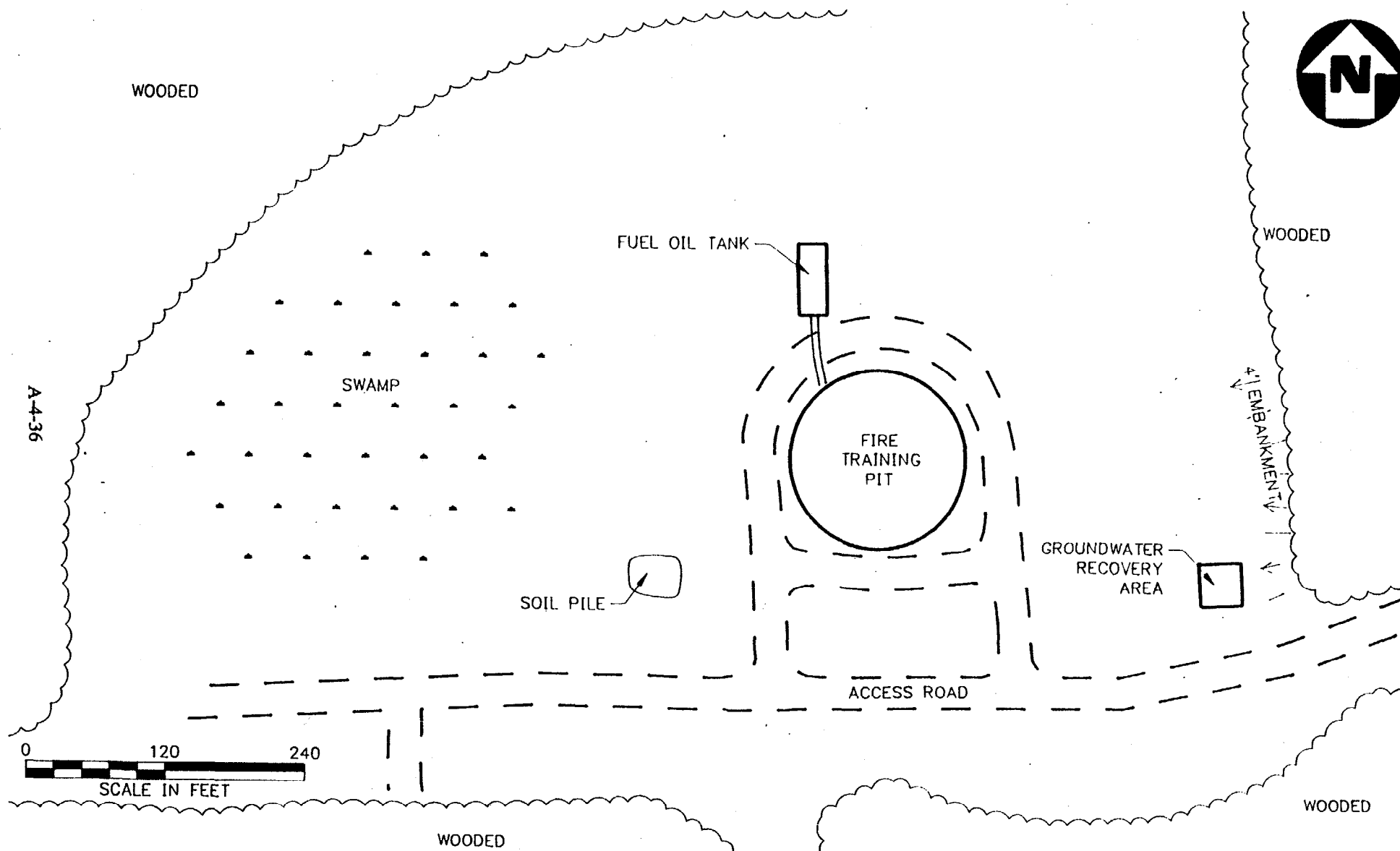
Existing survey monuments within NWIRP Calverton may be utilized as reference points. As an alternative, a Global Positioning System (GPS) may be required to establish survey control. Horizontal locations will be surveyed to NWIRP, Calverton coordinates, which can be tied to the New York State Plane Coordinate System.

All horizontal locations will be surveyed to the nearest 0.10 foot. Elevations will be referenced to the 1929 North American Datum. Monitoring well elevations will be surveyed to the nearest 0.01 foot at the ground surface, the top of the PVC riser pipe, and the top of the steel protective casing. Ground surface elevations of other sampling locations will also be surveyed to the nearest 0.01 foot.

4.5 SITE 2 - FIRE TRAINING AREA

4.5.1 Site Background

The fire training area is located on the eastern side of a 9-acre clearing in the south central area of the facility (Figure 1-3). A circular, concrete pit in the southeast corner of the clearing is used to contain liquids for the fire



SITE LAYOUT MAP
SITE 2 - FIRE TRAINING AREA
NWIRP, CALVERTON, NY

FIGURE 4-5

training exercises (Figure 4-5). The pit is approximately 50 feet in diameter and is located about 750 feet north and 1,000 feet west of the facility south gate. A concrete curb approximately 8 inches high forms the walls of the pit. A 1,000-gallon, steel, above-ground, fuel storage tank, located approximately 75 feet north of the training pit, is currently used to store fuels. A 6,000 gallon underground fuel storage tank was located north of the training area prior to 1982 (Navy, 1987).

Eighteen groundwater monitoring wells are located in the area of the fire training area, the majority of which are located to the east and southeast of the pit. A groundwater recovery unit, including a pumping well, an oil recovery well, and an oil/water storage tank, is located within a fenced area southeast of the pit at Well W-2.

The eastern portion of the fire training area was partially excavated at an unknown time. A small embankment up to 4 feet high is located along the eastern edge of the area and a dirt access road is located along the southern edge. The fire training area is surrounded by woodlands on all sides. The majority of the areas within the clearing to the west of the training ring are covered by marsh vegetation.

4.5.2 Site Specific History

The fire training area has been used by Grumman and Navy crash rescue crews as a training area since 1955, and possibly as early as 1952. According to the IAS, soil disturbances in the area were continuously evident in historical photographs. Before 1982, activities at the site consisted of clearing an area up to 100 feet or more in diameter and creating an earthen berm surrounding the area. The bermed area was then filled with a layer of water. Waste fuels, oils, and waste solvents were floated on the water and ignited. The IAS reports that up to 450 gallons of waste solvent were mixed with up to 2,100 gallons of waste fuel per year for use in the training exercises. Aircraft sections were sometimes placed in the area to simulate actual crash conditions. After 1975, waste solvents were reportedly no longer mixed with the material to be ignited; only waste fuel and oil was used. In 1982, the practice of using earthen berms was halted after the construction of a curbed, concrete pit approximately 50 feet in diameter (Navy, 1986).

Fire fighting materials used in the exercises on site included aqueous fire fighting foam (AFFF), gaseous Halon 1301, water, and dry chemical extinguishers (Navy, 1986).

A 6,000-gallon, underground storage tank located north of the fire training pit was used for an unknown time before a 1982 to store waste fuels and solvents at the site. A spill of an unknown amount of liquid (less than 6,000 gallons) originated from this tank in August 1982 (see Appendices A and B). Marine Pollution Control (MPC) of Calverton, New York removed a total of 327 cubic yards of contaminated soil from the tank and spill areas in late

August and early September 1982 as of result of the spill. Four groundwater monitoring wells were installed in the spill area in August 1982 (Navy, 1986; MPC, 1990-1991; Ohlman, 1985).

After the spill cleanup, a curbed, concrete, fire ring was constructed to prevent further soil contamination by waste fuels. A 1,000-gallon, above-ground fuel tank was installed to replace the 6,000-gallon tank (Navy, 1986).

A second spill of approximately 300 gallons of waste No. 2 fuel oil occurred in 1983. The spill emanated from a leak in the piping leading from the 1,000-gallon tank. Seven additional monitoring wells were subsequently installed by MPC to monitor potential contamination related to the spills. By early 1987, a total of 12 wells were located in the area. MPC installed an additional 6 wells on November 23, 1987 (Navy, 1986; MPC, 1990-1991).

A groundwater recovery well and oil-water separation system was installed at the fire training area in December 1987. The system uses a pumping well, an oil recovery well, and an oil/water separation tank (MPC, 1990-1991).

According to the IAS, hazardous materials expected to be associated with the fire training area include POLs; waste solvents such as toluene, methyl ethyl ketone, and lacquer thinner; and possibly soluble lead from fuels (Navy, 1986). There are also unconfirmed reports of drum burying activities at the fire training area.

The fire training area has been the scene of the largest remedial activity at the site, resulting from the spill of as much as 6,000 gallons of waste fuel oil in August 1982. The fuel spilled to an earth-bermed area and then spread to the southeast. Crews from Grumman Aerospace and MPC, of Calverton, New York, collected free liquids in the spill area. By August 31, 1982, MPC removed 227 cubic yards of contaminated soil from the spill area. Four monitoring wells were installed during that week; oil globules were observed in one well when sampled on September 3, 1982. MPC completed the removal of an additional 100 cubic yards of soil by September 7, 1982, mostly in the area of the fire training area access road. An additional 7 wells were installed in 1983, after a second small spill in the area. Another small area of soil was excavated in 1990/1991 to the southeast of the fire training ring as a result of fuel spillage. The excavation was approximately 12 feet by 12 feet by 6 feet deep (Navy, 1986, 1976; MPC, 1990-1991; Ohlman, 1985).

By November 1987, a total of 18 monitoring wells had been installed in the fire training area by MPC. A groundwater recovery system was installed in 1987. Floating oil and small amounts of water are periodically pumped into a 250 gallon holding tank for disposal.

4.5.3 Sampling Rationale

The Fire Training area is being investigated to fully delineate the nature and extent of contamination in soils, and groundwater at the site. Samples collected during the SI indicated soils and groundwater contamination (see Section 4.1.5). Sampling activities for the RFI will focus on identifying areas of buried drums or other disposal material, and delineating the extent of soils and groundwater contamination caused by buried material, Fire Training activities, and/or contaminated groundwater discharge (spraying) to the ground surface at the site.

4.5.4 Sampling Activities

The field investigation at Site 2 will consist of the following tasks:

- Geophysical Survey
- Soil Gas Survey
- Test Pit Excavation and Subsurface Soil Sampling
- Subsurface Soil Borings and Subsurface Soil Sampling
- Waste Sampling
- Surface Soil Sampling
- Temporary Well/Groundwater Sampling
- Permanent Monitoring Well Installation
- Groundwater Sampling - (permanent monitoring wells)
- Aquifer Testing
- Water Level Measurement
- Site Surveying

Soil, waste, groundwater, and surface water samples will be collected in accordance with NEESA methodology. Table 1-2 provides a summary of the chemical sampling program for the site. A summary list of all analytes, analytical methods, contract required quantitation limits, containers, preservatives, and holding times is provided on Table 3-1. A site specific summary of field activities, sampling, and sample analyses is presented in Table 4-3.

4.5.4.1 Geophysical Survey

A geophysical survey will be conducted at the Fire Training Area over the cleared areas of the site that are free of above ground interferences (fences, tanks, etc...) to locate buried objects (drums, tanks, underground utilities, etc...) (Figure 4-6A). This is a field screening activity designed to help focus the test pit and groundwater investigation.

TABLE 4-3

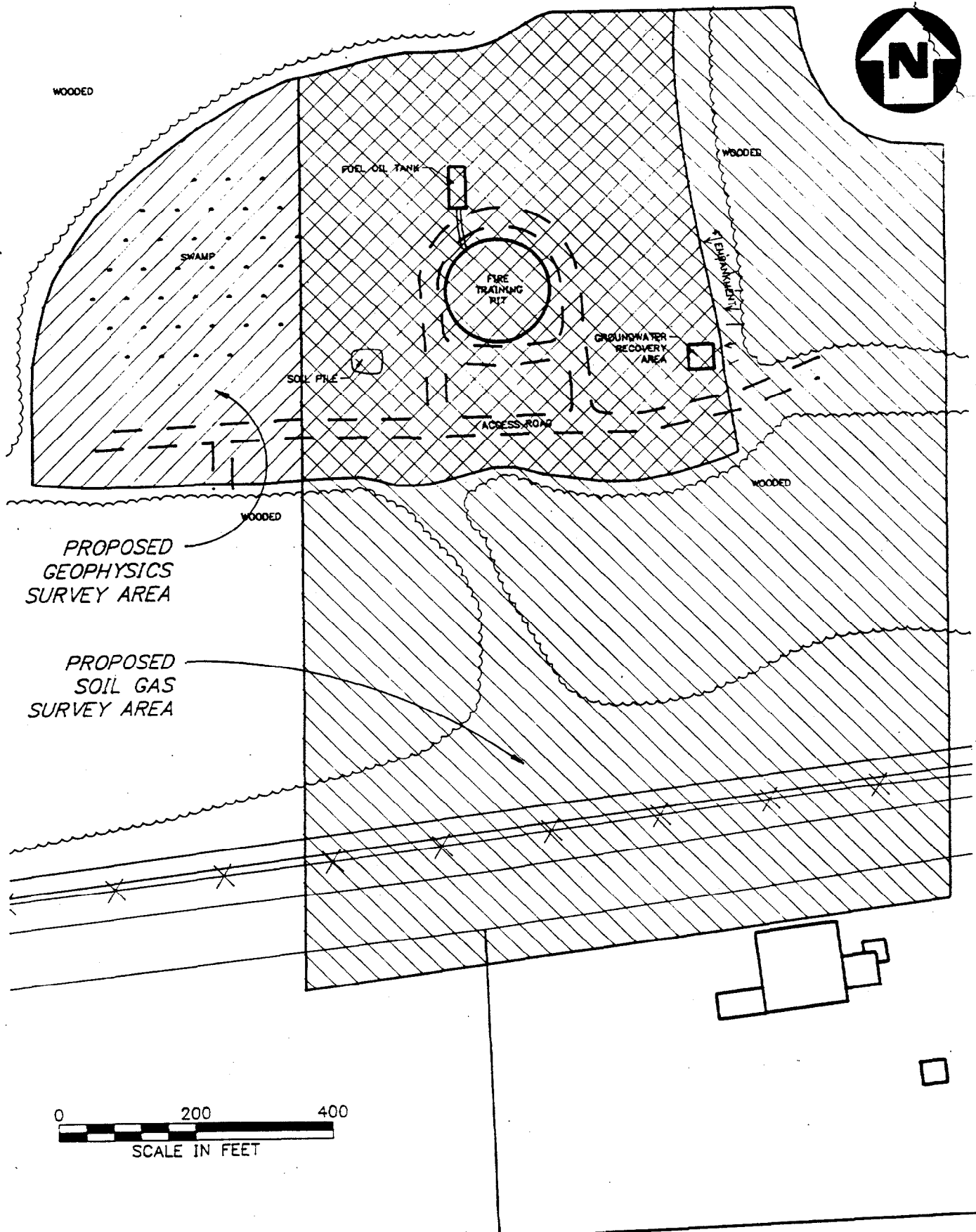
**SITE 2 - FIRE TRAINING AREA - FIELD ACTIVITIES
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK
(SEE TABLE 1-2 FOR ADDITIONAL DETAIL)**

TASK	DESCRIPTION OF ACTIVITIES	ANALYSIS¹
Test Pit Excavation/Sampling	Up to 7 test pits excavated; 1-2 soil samples/test pit	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ²
Subsurface Soil Boring/Sampling	Up to 10 subsurface soil borings; 2-3 samples/boring	TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics
Surface Soil Sampling	6 surface soil samples	TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ²
Permanent Monitoring Well Installation/Groundwater Sampling	7 shallow depth and 4 intermediate depth monitoring wells installed; 2 rounds of groundwater samples	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, and engineering parameters ³
Temporary Monitoring Well Installation/Groundwater Sampling	20 locations; 2 groundwater samples/well (2 depths)	Selected volatile organics (on- and offsite analyses)
Soil Gas Sampling	70 soil gas survey locations; 2 samples/location (2 depths)	Selected volatile organics (onsite analysis)
Waste Sampling	Up to 5 samples, if found, from test pits and/or soil borings	TCL volatiles, TCL semivolatiles, PCB/pesticides, TAL inorganics, hexavalent chromium, ignitability, corrosivity, reactivity, and other engineering parameters ²

1 - See Table 1-1 for breakdown of analytes per sample.

2 - Engineering parameters include particle size, bulk density, moisture content, TOC, TPH, BTU content, TCLP characterization, permeability, and organic lead.

3 - Engineering parameters include temperature, pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, COD, and organic lead.



**PROPOSED
GEOPHYSICS AND SOIL GAS INVESTIGATION AREAS
SITE 2 - FIRE TRAINING AREA
NWIRP, CALVERTON, NY**

FIGURE 4-6/



HALLIBURTON NUS
Environmental Corporation

The results of the geophysical survey will also be used to determine the location of test pits. If geophysical anomalies are not detected, test pits will not be excavated.

The survey will be conducted across a gridded area using approximately 10 foot - 15 foot line spacings. However, the specific size of the sampling grid may be modified by the subcontractor based on their experience. The survey will be performed using ground penetrating radar (GPR) techniques. GPR is a reflection technique using high frequency radio waves. From a small antenna which is moved slowly across the surface, energy is radiated downward into the subsurface, then reflected back to a receiving antenna, where variations in the return signal are continuously recorded. The data is presented as a continuous, cross-sectional image of the shallow subsurface, called a vertical profile. The radar waves are reflected from interfaces of material having different electrical properties. Radar penetration depths are highly site specific and dependent on site specific soil characteristics. Radar penetration from 1 to 10 meters is common. GPR has been used successfully to locate buried wastes, drums, and utilities. Initial, onsite analysis of the data is permitted by the picture-like quality of the radar results (Benson, et al., 1982).

4.5.4.2 Soil Gas Surveys

A contaminant-specific soil gas survey will be conducted at the Fire Training area in suspected areas of soil and groundwater contamination (Figures 4-6A,B). This is a field screening activity designed to delineate the extent of soil gas contamination and to help to focus the subsurface soil and groundwater investigation. The soil gas survey will be conducted across the source area, to the south and east of the site (downgradient of the site), and to the north of the Fire Training area where contaminated groundwater has been discharged to the surface.

An initial survey area with 100-foot grid spacings (approximately 30 locations) will be used to cover the source area of suspected soil and groundwater contamination (Figure 4-6B). An additional 40 optional locations are proposed to refine the initial survey area and to cover areas extending to the north, south, and east of the initial survey area. Optional locations may be located adjacent to initial survey points with positive soil gas detections to define the extent of soil gas contamination. In suspected areas outside of the source area (downgradient and the sprayed area to the north), secondary sampling locations will be gridded with a 200-foot spacing, extending outward from the source area grid.

The results of the soil gas survey will be used to define smaller areas of potential soil and/or groundwater contamination that will be further investigated using soil borings and temporary monitoring wells.

Soil gas samples will be collected from two depths at each sampling location (140 total samples): one approximately 3-5 ft below ground surface (bgs), and one just above the water table (approximately 10-12 feet bgs). Analyses of soil gas samples for selected volatile organic compounds will be conducted onsite, as possible using a mobile gas chromatograph (GC) for quick turn around of results.

Each potential soil gas sampling location will be marked with a surveyor's pin flag. Groundwater is estimated to lie between approximately 5 and 20 feet below ground surface (bgs) at the NWIRP, Calverton. Soil gas samples will be collected by driving a steel sampling probe into the ground to the desired sampling depth. The drive point on the probe is slotted to allow soil gas to flow through the sampling probe. The sampling probe will be evacuated with sample prior to collection the soil gas sample. The soil gas sample will be collected into an air sample bag from a dedicated inert sampling tube that connects the steel probe to a pump. Decontamination of steel sampling equipment will be performed as described in Section 4.11.

Prior to soil gas sample collection, a gas chromatograph compound library will be established using certified gas standards for the following target compounds:

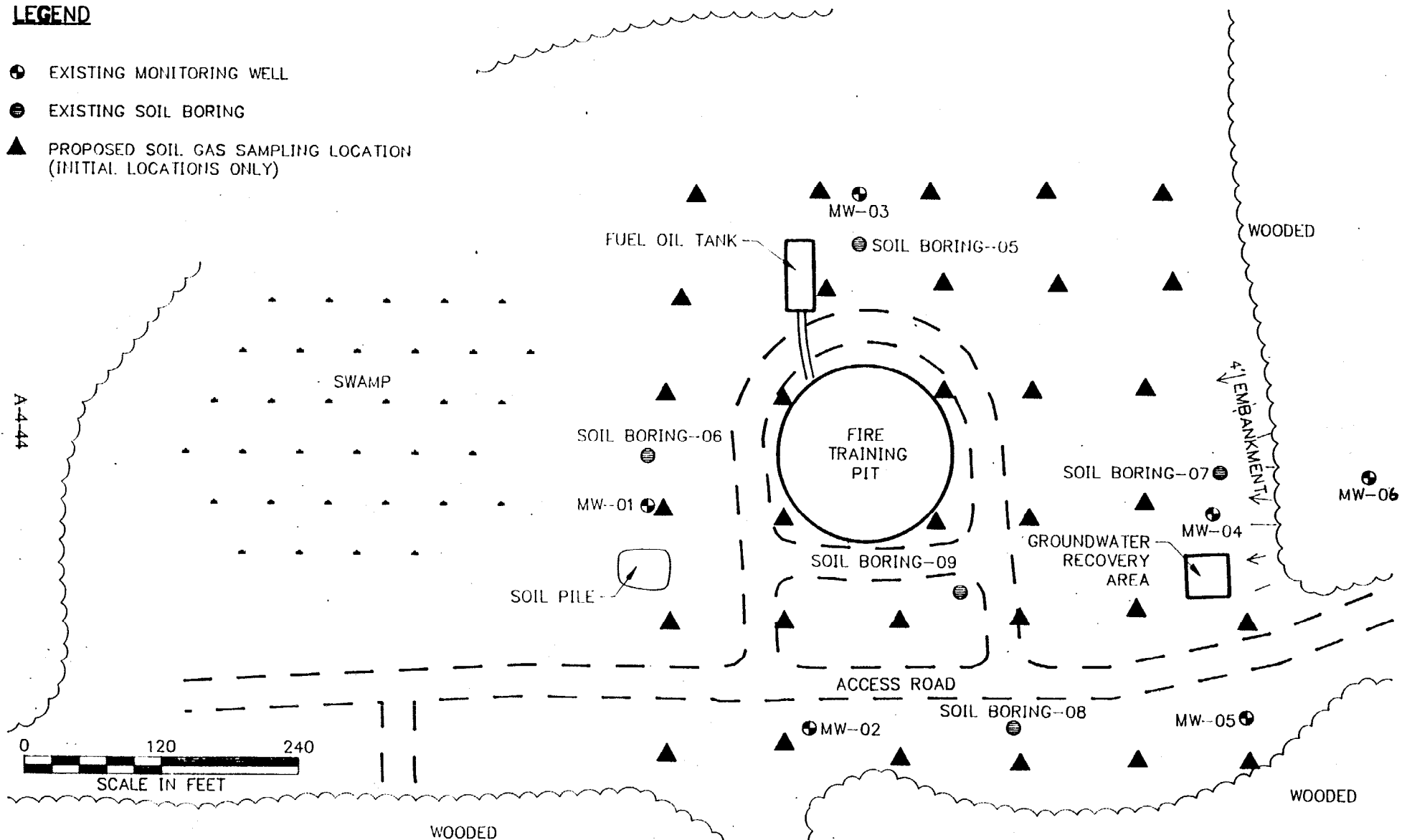
Benzene	Ethylbenzene
1,1-dichloroethene (DCE)	c-1,2 DCE
t-1,2-DCE	1,1-dichloroethane (DCA)
Trichloroethene (TCE)	Tetrachloroethene (PCE)
1,1,1 trichloroethane (TCA)	1,1,2-TCA
Chloroform	Carbon tetrachloride
Toluene	Total (m-, p-, and o-,) xylenes
Methylene chloride	Freon-113

4.5.4.3 Test Pit Excavation and Subsurface Soil Sampling

Up to 7 test pits will be excavated to delineate the nature and extent of disturbed material at the site and to confirm the presence or absence of buried drums. Test pit locations will be based on the combined results of the soil gas and geophysical surveys. In the event drums are encountered, a Drum Management Plan is provided in Appendix C.

LEGEND

- ⊕ EXISTING MONITORING WELL
- ⊙ EXISTING SOIL BORING
- ▲ PROPOSED SOIL GAS SAMPLING LOCATION (INITIAL LOCATIONS ONLY)



**PROPOSED INITIAL SOIL GAS SAMPLING LOCATIONS
SITE 2 - FIRE TRAINING AREA
NWIRP, CALVERTON, NY**

FIGURE 4-6B

Test pits will be completed as per Halliburton NUS SOP GH-1.8. A backhoe will be used to excavate to the water table, maximum reach of the backhoe (approximately 10 feet), or the extent of fill material, whichever is reached first. Samples for chemical analysis will be collected directly from the backhoe bucket.

One to two (1-2) subsurface soil samples will be collected per test pit: one in the fill material and one in the underlying natural material (if encountered). Test pits will be backfilled to the surface upon completion of each test pit using the excavated material. A test pit log will be completed by the field geologist for each test pit. A blank test pit log form is included in Appendix B. Test pit locations will be marked with a wooden stake for future reference.

Soil samples (approximately 11 samples plus 2 duplicate samples) collected from the test pits will be submitted to a fixed base laboratory for the following chemical analyses:

All soil samples will be analyzed for TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics.

Two of the 11 soil samples will be analyzed for an additional suite of engineering parameters including: particle size, bulk density, moisture content, permeability, TOC, TPH, BTU content, organic lead and TCLP characterization. One sample will be collected from the disturbed material and one sample will be collected from the underlying natural material.

4.5.4.4 Soil Borings and Subsurface Soil Sampling

Up to 10 subsurface soil borings will be drilled at the Fire Training Area. Up to six subsurface soil borings will be drilled at locations based on the results of the soil gas survey. An additional 4 soil borings will be drilled at predetermined locations within the source area (Figure 4-7). The 10 borings will investigate the nature and extent of subsurface soil contamination at the site, and the potential downward migration of contamination from disturbed material (fill, ruptured drums, etc..) into underlying soils. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A).

Subsurface soil borings will be drilled to the water table (approximately 12 feet bgs) using hollow stem auger drilling techniques. During drilling operations, Standard Penetration Tests and split-spoon sampling for lithologic description will be performed continuously in all soil borings. All split-spoon samples will be screened with an Organic Vapor Analyzer (OVA) and visually inspected for lithologic description. The split spoon samplers will have

a minimum outside diameter of 2 inches and be at least 2 feet long to fulfill the sample volume requirements for chemical analysis. Three-inch diameter split spoons will be used to collect samples that require additional volume (e.g. duplicate samples). The use of drilling fluids is prohibited during soil boring activities. Soil borings will be backfilled to the surface using drill cuttings. Soil boring locations will be marked with a wooden stake for future reference.

A complete log of each boring will be maintained by the field geologist. Appendix B contains an example of the boring log form. At a minimum, the boring log will contain the following information, when applicable, for each overburden boring:

- Sample numbers and types
- Sample depths
- Standard Penetration Test data
- Sample recovery/sample interval
- Soil density or cohesiveness
- Soil color
- Unified Soil Classification System (USCS) material description and symbol

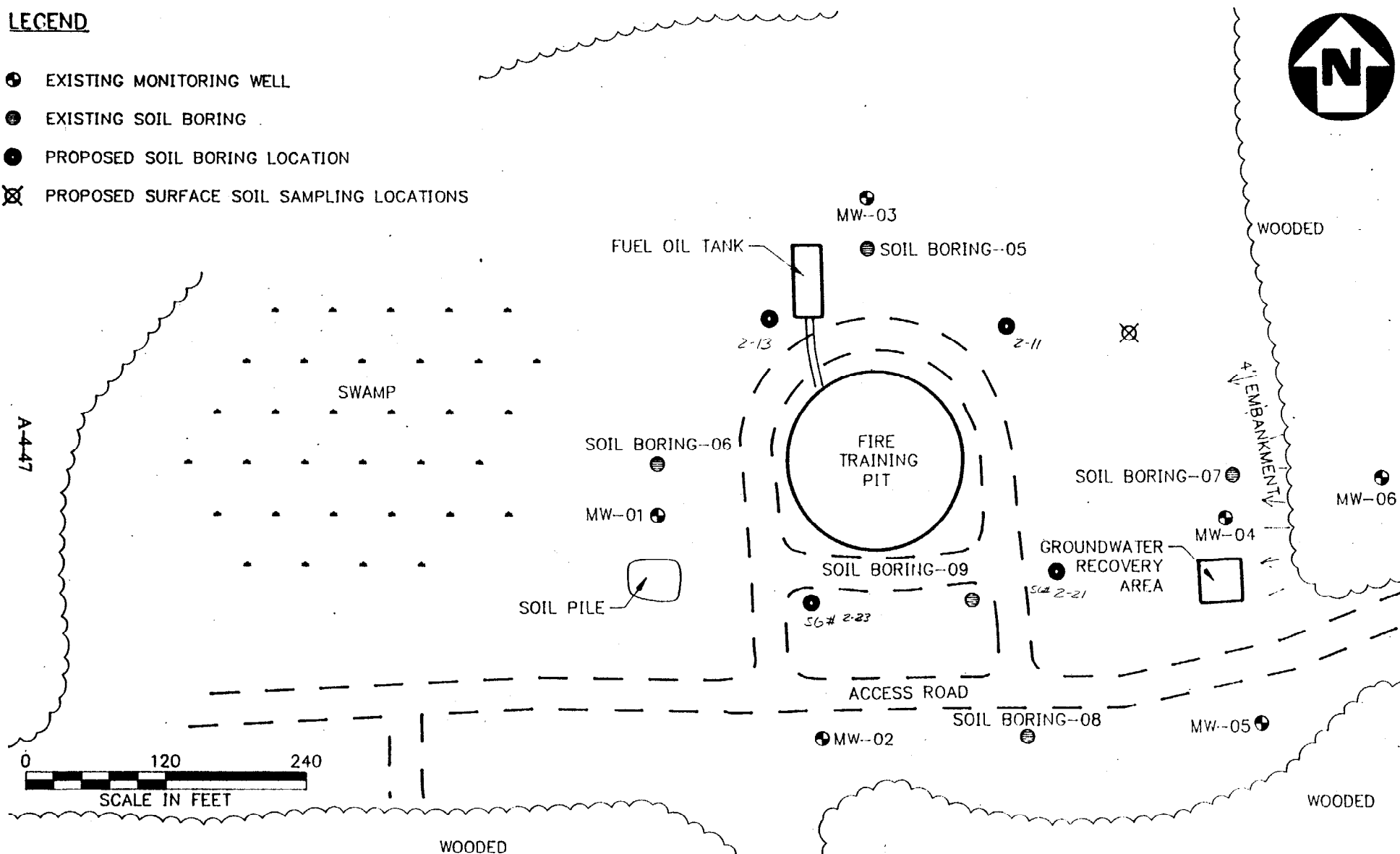
In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling method, and total depth of each borehole should be included on each boring log, as well as any other pertinent observations. Sample bottles containing soil samples collected solely for lithologic description will be numbered consecutively starting with S-1. In addition, the following information shall be recorded on the lid of the sample jars:

- Job number and name
- Boring and sample number
- Date
- Depth interval
- Blow counts

As an alternative to obtaining samples with hollow stem augers, during the subcontractor procurement process, alternative sample collection techniques will be considered. One potential alternative is the "direct push" method of obtaining samples. Under this method, the samples are collected by hydraulically driving a 1-inch diameter piston-type sampler to the top of the desired sample interval; the piston within the sampler is released and the pipe advanced through the target interval. The soil core then enters the sampler, which contains a non-reactive plastic

LEGEND

- EXISTING MONITORING WELL
- EXISTING SOIL BORING
- PROPOSED SOIL BORING LOCATION
- ⊗ PROPOSED SURFACE SOIL SAMPLING LOCATIONS



PROPOSED SOIL BORING AND SURFACE SOIL SAMPLING LOCATIONS
SITE 2 - FIRE TRAINING AREA
NWIRP, CALVERTON, NY

FIGURE 4-7

or stainless steel liner. After the drive rod is removed from the soil, the liner containing the soil column can be removed.

Two to three (2-3) samples will be collected for chemical analysis from each of the 10 borings (approximately 25 samples plus 3 duplicate samples)(Table 4-3). In each boring, one sample for chemical analysis will be collected from immediately above the soil/water interface. Additional samples for chemical analysis, from shallower depths in each boring, will be collected based on elevated OVA readings and visual observation of contamination (stained soils, etc...). Exact sampled intervals will be determined in the field.

Samples for chemical analysis will be collected by splitting the soil sample open longitudinally and extracting soil from the entire length of the interior of the sample. Portions of the sample submitted for TCL Volatiles analysis (when collected) will be placed directly into the required containers. Remaining portions of the sample will be homogenized and distributed to the appropriate containers. A stainless steel trowel will be used to place the sample into the required containers. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A). Decontamination of drilling and sampling equipment will be performed as described in Section 4.11.

Soil samples collected from the subsurface soil borings will be submitted to a fixed base laboratory for chemical analysis as follows:

All soil samples will be analyzed for TCL volatiles, TCL semivolatiles, PCB/pesticides and TAL inorganics.

4.5.4.5 Waste Sampling

Up to 5 discrete waste samples will be collected, if encountered, from test pits and/or soil borings. Samples will be collected in accordance with Halliburton NUS SOP GH-1.3 (Appendix A). Decontamination of sampling equipment will be conducted as described in Section 4.11. Waste samples will not be collected from drums uncovered during test pit activities. Discrete waste samples will be collected from material leaking from ruptured drums, if encountered.

Waste samples will be analyzed for the following waste characterization parameters: TCL volatiles, TCL semivolatiles, pesticides/PCBs, TAL inorganics, hexavalent chromium, TCLP characterization, ignitability, corrosivity, reactivity, particle size, bulk density, moisture content, TOC, TPH, and BTU content.

4.5.4.6 Surface Soil Sampling

Seven surface soil samples (6 samples plus 1 duplicate sample) will be collected from 0-6 inches at 6 locations. Exact locations will be determined in the field based on visual observations of the area. Four of the samples will be collected in areas of stressed vegetation or visual surface soil contamination. Two sample locations will be collected from near the source area (Figure 4-7).

Surface soil samples will be collected using stainless steel trowels. The top several inches of soil will be removed before obtaining each sample. The grab samples will be placed directly into the required containers. Surface soil sample locations will be marked with a wooden stake for future reference. Decontamination of sampling equipment will be completed as described in Section 4.11. A blank sample log form is included in Appendix B.

Surface soils will be submitted to a fixed base laboratory for chemical analysis as follows:

All surface soil samples will be analyzed for TCL semivolatiles, PCB/pesticides, and TAL inorganics.

One surface soil sample will be selected by the field geologist to be analyzed for additional suite of engineering parameters including: particle size, bulk density, moisture content, permeability, TOC, TPH, BTU content, organic lead, and TCLP characterization.

4.5.4.7 Temporary Well/Groundwater Sampling

Approximately 40 groundwater samples at 20 locations will be collected from temporary monitoring wells. The temporary monitoring wells may consist of a well screen temporarily installed in a subsurface boring, a drive point, or a geoprobe/hydropunch-type sampling point. Samples will be collected at two depths: one at the water table and one approximately 20-30 ft below the water table. Samples may be analyzed onsite for a suite of volatile organic compounds using a mobile GC for quick turn around. Ten percent (10%) of these samples will be sent to an offsite fixed base laboratory for chemical analysis to confirm the results of the field based analysis. The results of the soil gas survey will be used to delineate areas of potential groundwater contamination. Initial temporary well/groundwater sampling locations will be based on a grid pattern (approximately 50-foot spacing) across the area of suspected groundwater contamination defined by the soil gas survey. Secondary sampling locations will be located based on the analytical results of the initial samples and will be designated to define the extent of groundwater contamination.

4.5.4.8 Permanent Monitoring Well Installation

Permanent monitoring wells will be installed based on the results of the soil gas survey, geophysical survey, soil borings, and field-based groundwater sampling and analysis activities described in the preceding sections. It is expected that up to 11 permanent monitoring wells will be installed as follows:

7 shallow depth wells

1 upgradient well

3 wells near or in the source area

3 downgradient wells

4 intermediate wells (paired to shallow depth wells)

1 upgradient well

1 source area well

2 downgradient wells

If possible, existing monitoring wells can be used for this investigation and fewer new monitoring wells will be installed. The use of existing monitoring wells will be dependant on their present condition and location relative to soil gas and geophysical anomalies and/or suspected soil and groundwater contamination.

Monitoring well drilling and installation activities will be conducted as per Haalliburton NUS SOP GH-1.3, GH-1.5, and GH-1.7. Boring logs will be completed as described in section 4.5.4.4. Boring logs will be completed and as described in Section 4.5.4.4.

Shallow depth well borings will be drilled using hollow stem auger drilling techniques. Split spoon samples for lithologic description will be collected continuously to the water table and every 5 ft below the water table to the total depth of the boring. Subsurface soil samples for chemical analysis will not be collected from monitoring well borings. In shallow depth wells, the top of the screened interval will be positioned approximately 2 feet above the depth that groundwater is encountered during drilling.

Intermediate depth wells will be installed to approximately 80 ft bgs to help determine the vertical extent of groundwater contamination. These wells will be located approximately 10-20 ft from shallow depth wells to form shallow/intermediate depth well pairs. Intermediate depth well borings will also be advanced using hollow stem auger drilling techniques. If this method proves unsuccessful, alternative drilling techniques (mud rotary, and/or reverse circulation drilling) may be employed. Subsurface soil samples for chemical analysis will not be collected from intermediate depth monitoring well borings. Intermediate depth well borings will be geophysically logged

(gamma-ray log) to the total depth of the boring and split spoon samples for lithologic description will be collected every 10 ft.

After the monitoring well borings are drilled to the desired depth (8-inch minimum diameter boring), the well screen and riser pipe will be installed through the augers (if used) to the desired depth. The annulus of the boring around the well screen, and 2 to 3 feet above the well screen, will be backfilled with clean silica sand (No. 20 to 30 U.S. Standard Sieve size or as determined by the site geologist). A bentonite pellet, or equivalent, seal (minimum 2-foot thickness) will then be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. The remainder of the boring annulus, from the seal to the ground surface, will then be backfilled with cement/bentonite grout using a tremie pipe. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted tape measure. A monitoring well construction form will be completed for each well. A sample well construction form is included in Appendix B.

All monitoring wells will be constructed of 4-inch I.D. PVC flush-joint riser pipe and flush-joint factory slotted well screen. Well screen slots shall be no larger than 0.02 inches. All well screens will be 10 feet in length. A schematic diagram showing typical well construction details is included in Appendix A.

A 6- to 8-inch diameter protective steel casing equipped with a locking steel cap will be installed around each well. These casings will be grouted a minimum of three feet into the ground and will have at least one drain hole positioned approximately 0.5 feet above the ground surface. A 0.5-foot thick concrete apron measuring 2 feet by 2 feet and equipped with 3 steel barrier posts will be constructed equally portioned around the casing of each well. All monitoring well locks will be keyed alike.

The monitoring wells will be developed after installation to remove fine material and sediments from the area around the well screens and to remove drill cuttings and residual fluids from the area around the monitored interval of the boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist. Wells will be developed until water removed is visibly clear of suspended solids or until approved by the field geologist. Wells will not be developed until a minimum of 24 hours has elapsed after installation of the cement/bentonite grout.

4.5.4.9 Groundwater Sampling

Groundwater samples (estimated 11 samples plus 2 duplicate samples) will be collected from all new monitoring wells at the site. Two sampling rounds will be performed; one round during the wet season (March to May) and one round during the dry season (August to October). Groundwater sampling will be conducted in accordance with

Halliburton NUS SOP SA-1.1. Prior to obtaining samples, water levels will be measured and the wells will be evaluated using an interface probe for the detection of immiscible phase liquids. Each monitoring well will be purged using a dedicated stainless steel bailer or a non-dedicated suction pump and disposable polyethylene tubing. Three to six well volumes will be purged. Field measurements of pH, temperature, and specific conductance will be taken for each well volume during purging according to NUS SOP SF-1.1: Section 5. Stabilization of the above parameters is defined as follows: temperature $\pm 1^{\circ}\text{C}$, pH ± 0.2 units, SC ± 5 percent. If these parameters do not stabilize after 3 volumes, up to 6 volumes may be removed, as determined by the field geologist. If the wells are purged dry with fewer than three well volumes removed, the wells will be sampled when the water level in the well recovers to at least 70% of the original capacity, or within 24-hours of purging, whichever is first. The exception to this will be samples to be analyzed for volatile organics. Samples for volatile organics will be collected within 3 hours from the time of well purging.

Dedicated stainless steel bailers with dedicated polypropylene rope as bailing line will be used for sample collection.

All pertinent field data shall be recorded on the appropriate sample log sheet (Appendix B) and in the field log book.

Groundwater samples will be analyzed at a fixed-base laboratory as follows:

Analyze all groundwater samples for TCL volatiles, TCL semivolatiles, PCB/pesticides, and TAL inorganics.

Analyze 3 of the 11 groundwater samples (2 samples and 1 duplicate sample) for the following additional engineering parameters: pH, TSS, TDS, Alkalinity, hardness, organic lead, TPH, TOC, BOD, and COD. One sample and a duplicate sample will be collected from a source area or downgradient shallow depth well. One sample will be collected from a source area or downgradient intermediate depth well.

4.5.4.10 Aquifer Testing

A constant rate pumping test will be performed to determine the hydraulic characteristics of the flow system underlying the site. The existing pumping well associated with the groundwater recovery system will be used for this test. Selected existing and newly installed monitoring wells will be used as observation wells during the pumping test. The pumping test will be conducted using either a surface pump or a submersible pump. The pump will be equipped with clean polyethylene discharge hose. The pumping test will be performed as per the general procedures described in Halliburton NUS SOP GH- 2.3 (Appendix A).

The optimum pumping rate will be established by performing a preliminary step-drawdown test. The actual pumping test duration will be determined in the field based on the aquifer response to pumping, with a minimum duration of 12 hours and a maximum duration of 36 hours. Water levels will be periodically measured in the pumping well and observation wells throughout the duration of the test. Water level recovery measurements will be collected from immediately upon stoppage of pumping until the water level in the pumping well has recovered to approximately 90% of the original (pre-pumping) water level. Water levels will be monitored during pumping and recovery tests using hand measurements and Insitu Hermit data loggers with pressure transducers.

The data will be evaluated using standard analysis techniques. The results of the pumping test will be used to calculate aquifer characteristics, determine groundwater migration rates, in models to predict potential future contaminant concentrations at downgradient locations, and may be used to design groundwater extraction/treatment systems.

4.5.4.11 Water Level Measurement

Two complete rounds of water levels will be collected from the new monitoring wells. Each round of measurements will be taken within a 2-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements will be taken with an electronic water level indicator using a marked or notched location at the top of the PVC well casing as the reference point for determining depths to water. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate field logbook and on water level measurement forms (attached in Appendix B).

4.5.4.12 Site Surveying

The vertical and horizontal location of the corners of soil gas and geophysical survey grids, temporary groundwater sampling locations, monitoring wells, test pits, subsurface soil borings, and surface soil sampling points will be surveyed upon completion of field activities.

Existing survey monuments within NWIRP Calverton may be utilized as reference points. As an alternative, a Global Positioning System (GPS) may be required to establish survey control. Horizontal locations will be surveyed to NWIRP, Calverton coordinates, which can be tied to the New York State Plane Coordinate System.

All horizontal locations will be surveyed to the nearest 0.10 foot. Elevations will be referenced to the 1929 North American Datum. Monitoring well elevations will be surveyed to the nearest 0.01 foot at the ground surface, the

top of the PVC riser pipe, and the top of the steel protective casing. Ground surface elevations of other sampling locations will also be surveyed to the nearest 0.01 foot.

4.6 SITE 6A - FUEL CALIBRATION AREA

4.6.1 Site Background

The fuel calibration area is located approximately 2,000 feet north of River Road and 2,000 feet west of the south gate (Figure 1-3). The fuel calibration area consists of a concrete pad (approximately 250 feet by 250 feet)(Figure 4-8).

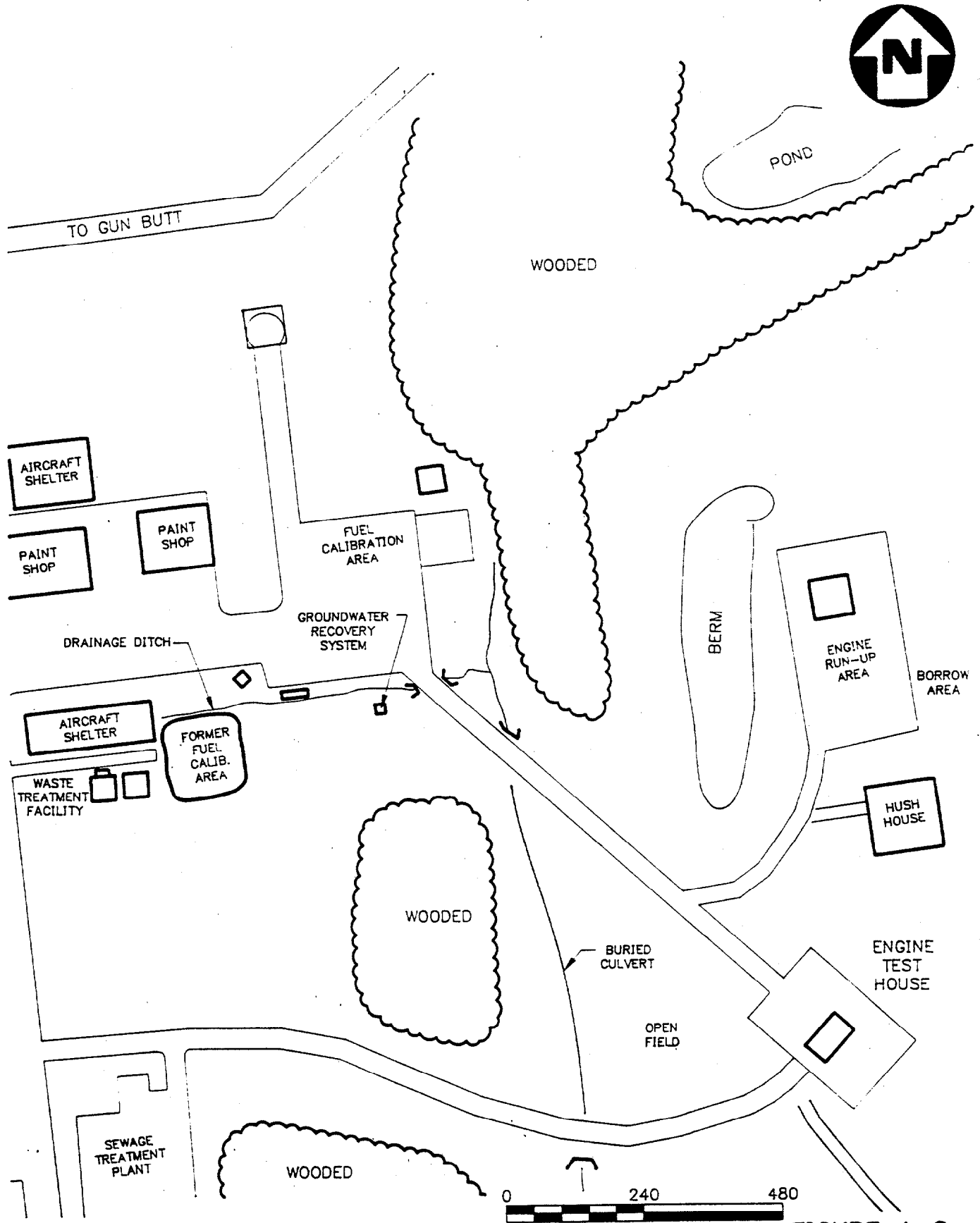
The eastern edge of the concrete pad is currently used for fuel calibration activities. The southern edge of the pad was formerly used for the same activity; a shed, piping, and fuel filtering devices are still located in the area (USGS, 1967; Navy, 1986).

Structures related to the fuel calibration pad include the engine test house, the hush house, and the engine runup area, all of which are connected to the pad by a road leading from its southeast corner. The engine test house is located 750 feet to the southeast, the hush house 600 feet to the east-southeast, and the engine runup area approximately 500 feet to the east (USGS, 1967).

An open field, approximately 10 acres in area, is located immediately south of the calibration pad and is included as part of Site 6A. An older fuel calibration area was located at the northwestern corner of the field, in an area now partially covered by a waste treatment facility. No physical evidence exists of the former calibration area. An area east of the wastewater treatment plant and south of the fuel pad is the former site of a septic leach field. No observable physical evidence exists regarding the leach field (USGS, 1967; Navy, 1986).

Eighteen monitoring wells are located at the southeast corner of the calibration pad, the majority of which are in the field to the south. A groundwater recovery unit consisting of a pumping well, and oil recovery well, and a oil/water separation tank is located in a fenced area south of the pad. A discharge pipe leads from the tank into the drainage ditch, and terminates within the buried culvert mentioned earlier (Navy, 1986; MPC, 1990-1991).

The fuel calibration pad is sloped very gently to the south and east. Drainage ditches are located parallel to the southern and eastern edges of the pad. The two ditches meet east of the south corner of the pad, and enter a southward trending buried culvert. The culvert outfalls to an another drainage ditch approximately 625 feet south



SITE LAYOUT MAP
SITE 6A - FUEL CALIBRATION AREA
NWIRP, CALVERTON, NEW YORK

FIGURE 4-8



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of the pad. This ditch continues to a shallow pond located approximately 1,500 feet south-southeast of the pad (USGS, 1967).

The fuel calibration pad and associated structures are located on the eastern edge of the developed areas of the facility. Aircraft hangers and painting shops are located east of the pad. Several small drainage collection ponds are located to the north, east, and south of the fuel calibration area, all within 1,500 feet (USGS, 1967; Navy, 1986).

4.6.2 Site Specific History

The fuel calibration and related facilities are used in the testing of aircraft fuel and engine systems. Aircraft fuel delivery systems are pressurized with fuel in the calibration area to test for leaks. The testing may have resulted in frequent, small, fuel spills to the area's pavement (Navy, 1986; Ohlman, 1985).

The present calibration area is a concrete pad, approximately 2 acres in size, located at the east-central edge of the industrial area of the facility. At this time, the majority of activity takes place on the eastern edge of the pad. In previous years, activity was centered along the southern edge of the pad. An abandoned fuel distribution set-up, including piping, manifolds, and filters, is located south of the concrete pad. The original fuel calibration area at the facility was located approximately 250 feet southwest of the present area. The original area is now grass covered (Navy, 1986).

Three ancillary structures to the fuel calibration area are located to the southeast. These include the covered engine runup area, the hush house, and the engine test house. The engine runup area is used to test jet engines and fuel system for leaks while operating the engines at elevated speeds. An excavated area several acres in size is located east of the engine runup area blast fence; its use is unknown. The hush house is a specially constructed building that allows aircraft engines to be operated at high speeds while containing the associated noise. The engine test house is outfitted to operate jet engines before installation in aircraft (Navy, 1986).

The primary environmental concern at the fuel calibration area is the spillage of aircraft fuels. According to the IAS, as many as 230 gallons of fuel are recorded to have been spilled in these areas. The majority of the spillage is expected to be concentrated in the areas surrounding the main fuel calibration pad (See Appendix B) (Navy, 1986; Ohlman, 1985).

The grass field located immediately south of the present fuel calibration area (and east of the former calibration area) is the former location of a septic system leach field. The system was active before the construction of the

facility's sanitary sewage treatment plant in 1970. The leach field is believed to have received primarily sanitary wastes; however, it is not known whether industrial process wastes entered the leach field. No physical evidence of the leach field was found during the site inspection (Navy, 1986).

Eighteen monitoring wells were placed south and southeast of the fuel calibration pad by MPC between March 1984 and November 1987. A groundwater recovery unit including a pumping well, an oil recovery well, and an oil/water separator tank was installed in 1987. The tank is connected to a pipe that follows the drainage ditch paralleling the southern edge of the calibration pad. The ditch enters a buried culvert southeast of the pad and eventually discharges to a small pond 1,500 feet south of the calibration pad. The recovery system pipe ends in the underground culvert. Red iron staining was observed during the site investigation in the ditch adjacent to the oil/water tank separation outfall and at the end of the culvert. The staining in the ditch near the oil/water separator reportedly resulted from a break in the piping early in 1990 (USGS, 1967; Navy, 1986; MPG, 1990-1991).

Remedial activity at the fuel calibration area includes the installation of a groundwater recovery well by MPC. This well is similar in construction to the well in the fire training area. Between 1984 and 1987, a total of 18 monitoring wells have been installed in the fuel calibration area. No records were reviewed indicating that any soil removal took place in the area.

4.6.3 Sampling Rationale

The Fuel Calibration area is being investigated to fully delineate the nature and extent of contamination in soils, and groundwater as the result of fuel spills at the site. Samples collected during the SI indicated soils and groundwater contamination (see Section 4.1.5). Sampling activities for the RFI will focus on identifying the extent of soils and groundwater contamination in the areas adjacent to the concrete pad at the site due to fuel calibration activities at the site.

4.6.4 Sampling Activities

The field investigation at Site 6A will consist of the following tasks:

- Soil Gas Survey
- Subsurface Soil Borings and Subsurface Soil Sampling
- Surface Soil Sampling
- Temporary Well/Groundwater Sampling
- Permanent Monitoring Well Installation

- Groundwater Sampling - (permanent monitoring wells)
- Aquifer Testing
- Water Level Measurement
- Site Surveying

Soil, waste, groundwater, and surface water samples will be collected in accordance with NEESA methodology. Table 1-3 provides a summary of the chemical sampling program for the site. A summary list of all analytes, analytical methods, contract required quantitation limits, containers, preservatives, and holding times is provided on Table 3-1. A site specific summary of field activities, sampling, and sample analyses is presented in Table 4-4.

4.6.4.1 Soil Gas Survey

A contaminant-specific soil gas survey will be conducted at the Fuel Calibration Area in suspected areas of soil and groundwater contamination (Figure 4-9). This is a field screening activity designed to delineate the extent of soil gas contamination and to help to focus the subsurface soil and groundwater investigation. The soil gas survey will be conducted across the source area and to the south and east of the site (downgradient of the site).

An initial survey area with 100-foot grid spacings (approximately 35 locations) will be used to cover the source area of suspected soil and groundwater contamination (Figure 4-9). An additional 40 optional locations are proposed to refine the initial survey area and to cover areas extending to the outward and downgradient of the initial survey area. Optional locations may be located adjacent to initial survey points with positive soil gas detections to define the extent of soil gas contamination. In suspected areas outside of the source area (downgradient), secondary sampling locations will be gridded with a 200-foot spacing extending outward from the source area grid.

TABLE 4-4

**SITE 6A - FUEL CALIBRATION AREA - FIELD ACTIVITIES
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK
(SEE TABLE 1-3 FOR ADDITIONAL DETAIL)**

TASK	DESCRIPTION OF ACTIVITIES	ANALYSIS¹
Subsurface Soil Boring/Sampling	Up to 14 subsurface soil borings; 2-3 samples/boring	TCL volatiles, TCL semivolatiles, TAL metals, lead, and engineering parameters ²
Surface Soil Sampling	6 surface soil samples	TCL semivolatiles, lead, and engineering parameters ²
Permanent Monitoring Well Installation/Groundwater Sampling	6 shallow depth and 4 intermediate depth monitoring wells installed; 2 rounds of groundwater samples; free product sampling if found	TCL volatiles, TCL semivolatiles, lead, and engineering parameters ³ ; BTU content, organic lead, and PCB/pesticides if free product found
Temporary Monitoring Well Installation/Groundwater Sampling	20 locations; 2 samples/location (2 depths)	Selected volatile organics (on- and offsite analyses)
Soil Gas Sampling	75 soil gas survey locations; 2 samples/location (2 depths)	Selected volatile organics (onsite analysis)

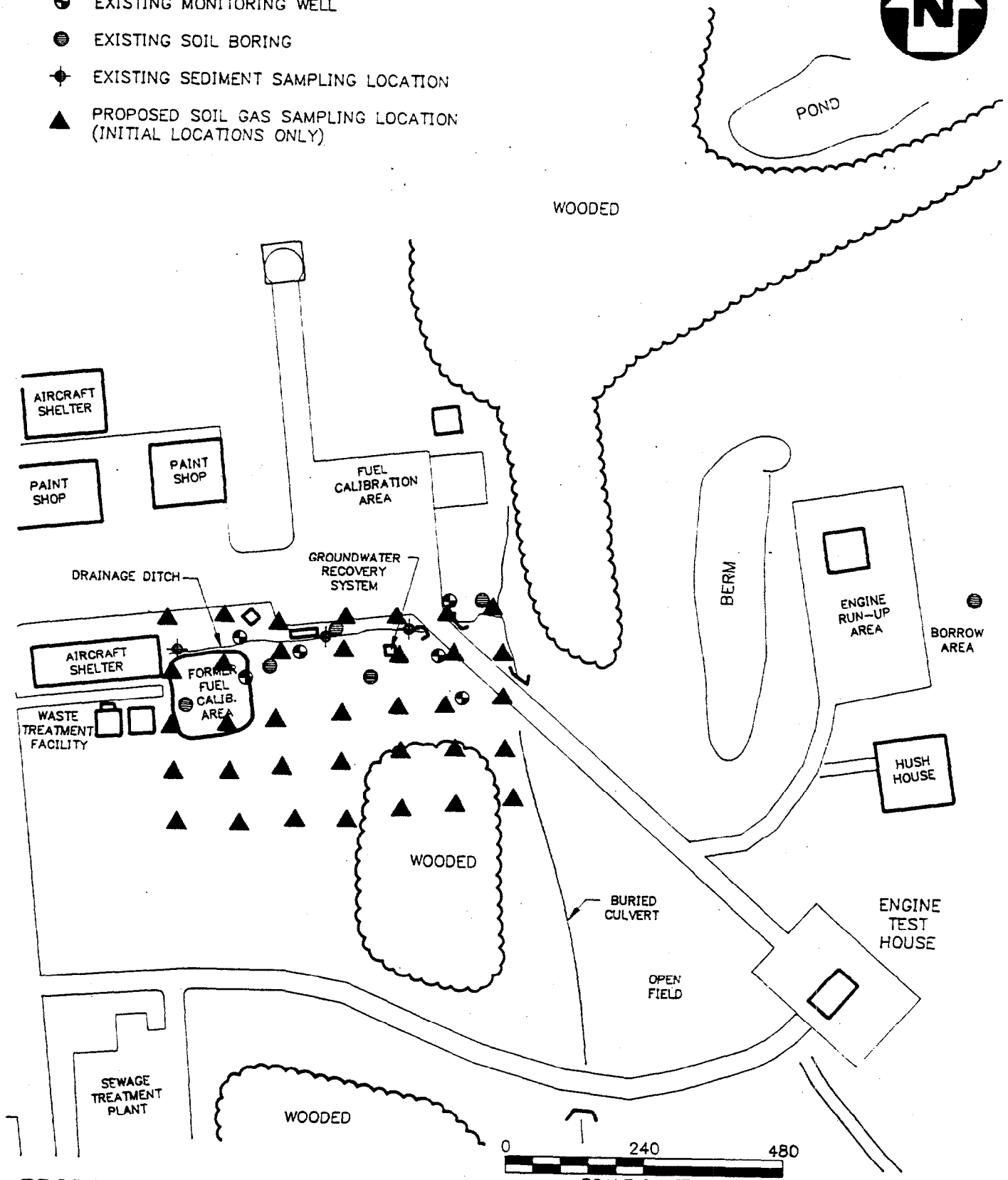
1 - See Table 1-1 for breakdown of analytes per sample.

2 - Engineering parameters include particle size, bulk density, moisture content, TOC, TPH, BTU content, TCLP characterization, permeability, and organic lead.

3 - Engineering parameters include temperature, pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, COD, and organic lead.

LEGEND

- ⊙ EXISTING MONITORING WELL
- EXISTING SOIL BORING
- ✦ EXISTING SEDIMENT SAMPLING LOCATION
- ▲ PROPOSED SOIL GAS SAMPLING LOCATION (INITIAL LOCATIONS ONLY)



PROPOSED SOIL GAS SURVEY LOCATIONS
SITE 6A - FUEL CALIBRATION AREA
NWIRP, CALVERTON, NEW YORK

FIGURE 4-9

A-4-60



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The results of the soil gas survey will be used to define smaller areas of potential soil and/or groundwater contamination that will be further investigated using soil borings and temporary monitoring wells.

Soil gas samples will be collected from two depths at each sampling location (150 total samples): one approximately 3-5 ft below ground surface (bgs), and one just above the water table (approximately 10-12 feet bgs). Analyses of soil gas samples for selected volatile organic compounds will be conducted onsite as before using a mobile GC for quick turn around of results.

Each potential soil gas sampling location will be marked with a surveyor's pin flag. Groundwater is estimated to lie between approximately 5 and 20 feet below ground surface (bgs) at the NWIRP, Calverton. Soil gas samples will be collected by driving a steel sampling probe into the ground to the desired sampling depth. The drive point on the probe is slotted to allow soil gas to flow through the sampling probe. The sampling probe will be evacuated with sample prior to collection the soil gas sample. The soil gas sample will be collected into an air sample bag from a dedicated inert sampling tube that connects the steel probe to a pump. Decontamination of steel sampling equipment will be performed as described in Section 4.11.

Prior to soil gas sample collection, a gas chromatograph compound library will be established using certified gas standards for the following target compounds:

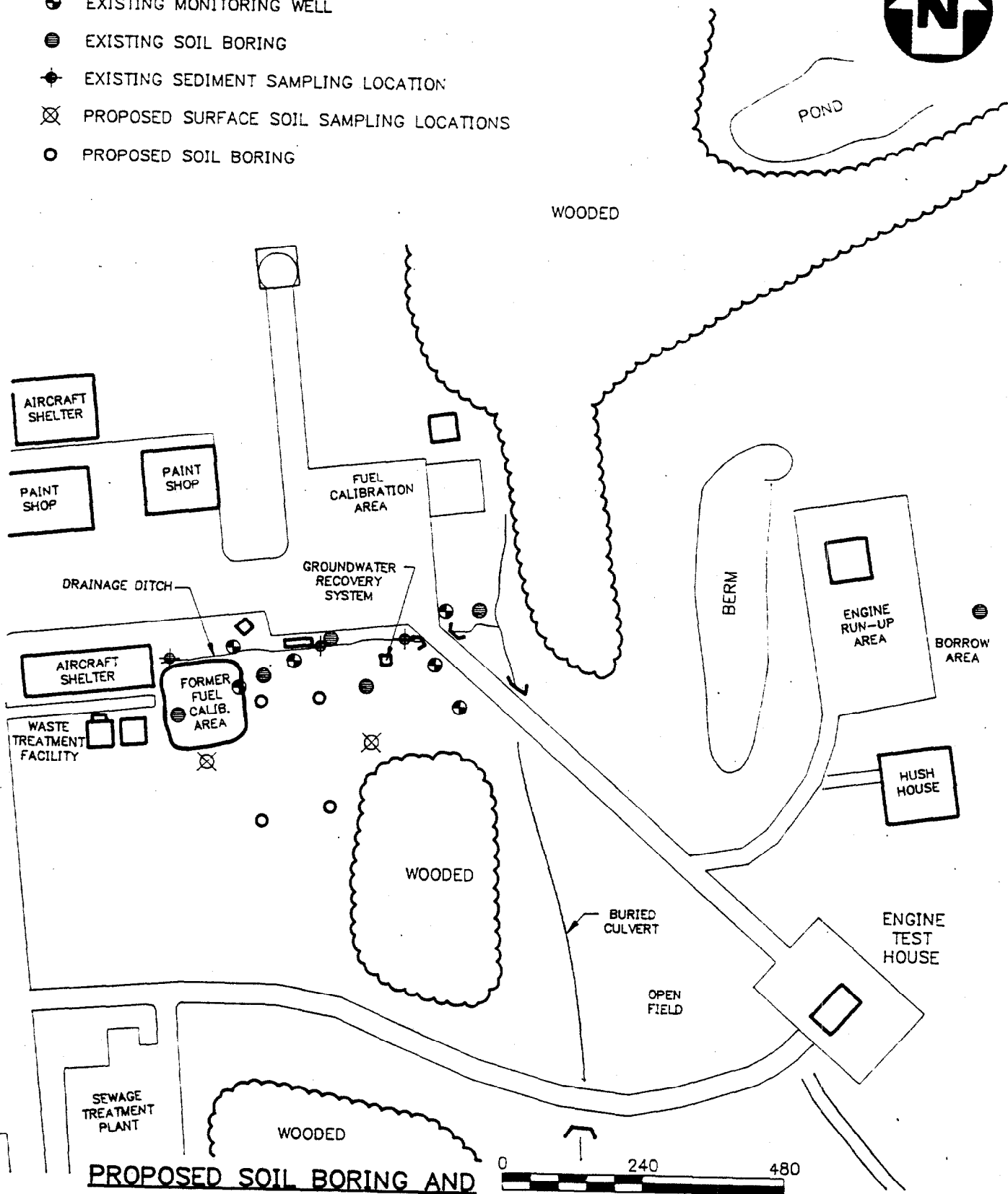
Benzene	Ethylbenzene
1,1-dichloroethene (DCE)	c-1,2-DCE
t-1,2-DCE	1,1-dichloroethane (DCA)
Trichloroethene (TCE)	Tetrachloroethene (PCE)
1,1,1 trichloroethane (TCA)	1,1,2-TCA
Chloroform	Carbon tetrachloride
Toluene	Total (m-, p-, and o-,) xylenes
Methylene chloride	Freon-113

4.6.4.2 Soil Borings and Subsurface Soil Sampling

Up to 14 subsurface soil borings will be drilled at the Fuel Calibration Area. Up to 10 subsurface soil borings will be drilled at locations based on the results of the soil gas survey. An additional 4 soil borings will be drilled at predetermined location within the source area (Figure 4-10). The 14 borings will investigate the nature and extent

LEGEND

- EXISTING MONITORING WELL
- EXISTING SOIL BORING
- ⊕ EXISTING SEDIMENT SAMPLING LOCATION
- ⊗ PROPOSED SURFACE SOIL SAMPLING LOCATIONS
- PROPOSED SOIL BORING



**PROPOSED SOIL BORING AND
SURFACE SOIL SAMPLING LOCATIONS
SITE 6A - FUEL CALIBRATION AREA
NWIRP, CALVERTON, NEW YORK**

FIGURE 4-10



of subsurface soil contamination at the site, and the potential downward migration of contamination into underlying soils and groundwater. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A).

Subsurface soil borings will be drilled to the water table (approximately 12 feet bgs) using hollow stem auger drilling techniques. During drilling operations, Standard Penetration Tests and split-spoon sampling for lithologic description will be performed continuously in all soil borings. All split-spoon samples will be screened with an Organic Vapor Analyzer (OVA) and visually inspected for lithologic description. The split spoon samplers will have a minimum outside diameter of 2 inches and be at least 2 feet long to fulfill the sample volume requirements for chemical analysis. Three-inch diameter split spoons will be used to collect samples that require additional volume (e.g. duplicate samples). The use of drilling fluids is prohibited during soil boring activities. Soil borings will be backfilled to the surface using drill cuttings. Soil boring locations will be marked with a wooden stake for future reference.

A complete log of each boring will be maintained by the field geologist. Appendix B contains an example of the boring log form. At a minimum, the boring log will contain the following information, when applicable, for each overburden boring:

- Sample numbers and types

- Sample depths

- Standard Penetration Test data

- Sample recovery/sample interval

- Soil density or cohesiveness

- Soil color

- Unified Soil Classification System (USCS) material description and symbol

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling method, and total depth of each borehole should be included on each boring log, as well as any other pertinent observations. Sample bottles containing soil samples collected solely for lithologic description will be numbered consecutively starting with S-1. In addition, the following information shall be recorded on the lid of the sample jars:

- Job number and name

- Boring and sample number

Date

Depth interval

Blow counts

As an alternative to obtaining samples with hollow stem augers, during the subcontractor procurement process, alternative sample collection techniques will be considered. One potential alternative is the "direct push" method of obtaining samples. Under this method, the samples are collected by hydraulically driving a 1-inch diameter piston-type sampler to the top of the desired sample interval; the piston within the sampler is released and the pipe advanced through the target interval. The soil core then enters the sampler, which contains a non-reactive plastic or stainless steel liner. After the drive rod is removed from the soil, the liner containing the soil column can be removed.

Two to three (2-3) samples will be collected for chemical analysis from each of the 14 borings (approximately 35 samples plus 4 duplicate samples)(Table 4-4). In each boring, one sample for chemical analysis will be collected from immediately above the soil/water interface. Additional samples for chemical analysis, from shallower depths in each boring, will be collected based on elevated OVA readings and visual observation of contamination (stained soils, etc...). Exact sampled intervals will be determined in the field.

Samples for chemical analysis will be collected by splitting the soil sample open longitudinally and extracting soil from the entire length of the interior of the sample. Portions of the sample submitted for TCL Volatiles analysis (when collected) will be placed directly into the required containers. Remaining portions of the sample will be homogenized and distributed to the appropriate containers. A stainless steel trowel will be used to place the sample into the required containers. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A). Decontamination of drilling and sampling equipment will be performed as described in Section 4.11.

Soil samples collected from the subsurface soil borings will be submitted to a fixed base laboratory for chemical analysis as follows:

All subsurface soil samples will be analyzed for TCL volatiles, TCL semivolatiles and Lead. Additionally, two of the samples will be analyzed for TAL metals.

2 of the 35 samples will also be analyzed for the following additional engineering parameters: particle size, bulk density, moisture content, permeability, TOC, TPH, BOD, COD, BTU content, organic lead, and TCLP characterization.

4.6.4.3 Surface Soil Sampling

Seven surface soil samples (6 samples plus 1 duplicate sample) will be collected from 0-6 inches at 6 locations. Exact locations will be determined in the field based on visual observations of the area. Four of the samples will be collected in areas of stressed vegetation or visual surface soil contamination that are free of pavement. Two samples will be collected from near the source area (Figure 4-10).

Surface soil samples will be collected using stainless steel trowels. The top several inches of soil will be removed before obtaining each sample. The grab samples will be placed directly into the required containers. Decontamination of sampling equipment will be completed as described in Section 4.11. A blank sample log form is included in Appendix B.

Surface soils will be submitted to a fixed base laboratory for chemical analysis as follows:

All surface soil samples will be analyzed for TCL semivolatiles, and Lead. Additionally, two of the samples will be analyzed for TAL metals.

One surface soil sample will be selected by the field geologist to be analyzed for an additional suite of engineering parameters including: particle size, bulk density, moisture content, permeability, TOC, TPH, BOD, COD, BTU content, organic lead, and TCLP characterization.

4.6.4.4 Temporary Well/Groundwater Sampling

Approximately 40 groundwater samples at 20 locations will be collected from temporary monitoring wells. The temporary monitoring wells may consist of well screen temporarily installed in a subsurface soil boring, a drive point, or a geoprobe/hydropunch-type sample point. Samples will be collected at two depths: one at the water table and one approximately 20-30 ft below the water table. Samples may be analyzed onsite for a suite of volatile organic compounds using a mobile GC for quick turn around. Ten percent (10%) of the samples will be sent to an offsite fixed base laboratory for chemical analysis to confirm the results of the field based analysis. The results of the soil gas survey will be used to delineate areas of potential groundwater contamination. Initial temporary well/groundwater sampling locations will be based on a grid pattern (approximately 50-foot spacing) across the area of suspected groundwater contamination defined by the soil gas survey. Secondary sampling locations will be located based on the analytical results of the initial samples and will be designated to define the extent of groundwater contamination.

4.6.4.5 Permanent Monitoring Well Installation

Permanent monitoring wells will be installed based on the results of the soil gas survey, soil borings, and field-based groundwater sampling and analysis activities described above. It is expected that 10 permanent monitoring wells will be installed as follows:

- 6 shallow depth wells
 - 1 upgradient well
 - 2 wells near or in the source area
 - 3 downgradient wells
- 4 intermediate wells (paired to shallow depth wells)
 - 1 upgradient well
 - 1 source area well
 - 2 downgradient wells

Monitoring well drilling and installation activities will be conducted as per Halliburton NUS SOP GH-1.3, GH-1.5, and GH-1.7. Boring logs will be completed as described in section 4.5.4.4. Boring logs will be completed and as described in Section 4.5.4.4. Boring logs will be completed and as described in Section 4.5.4.4.

Shallow depth well borings will be drilled using hollow stem auger drilling techniques. Split spoon samples for lithologic description will be collected continuously to the water table and every 5 ft below the water table to the total depth of the boring. Subsurface soil samples for chemical analysis will not be collected from monitoring well borings. In shallow depth wells, the top of the screened interval will be positioned approximately 2 feet above the depth that water is encountered during drilling.

Intermediate depth wells will be installed to approximately 80 ft bgs to help determine the vertical extent of groundwater contamination. These wells will be located approximately 10-20 ft from shallow depth wells to form shallow/intermediate depth well pairs. Intermediate depth well borings will be advanced using hollow stem auger, mud rotary, and/or reverse circulation drilling techniques. Subsurface soil samples for chemical analysis will not be collected from intermediate depth monitoring well borings. Intermediate depth well borings will be geophysically logged (gamma-ray log) from the water table to the total depth of the boring and split spoon samples for lithologic description will be collected every 10 ft.

After the monitoring well borings are drilled to the desired depth (8-inch minimum diameter boring), the well screen and riser pipe will be installed through the augers (if used) to the desired depth. The annulus of the boring around

the well screen, and 2 to 3 feet above the well screen, will be backfilled with clean silica sand (No. 20 to 30 U.S. Standard Sieve size or as determined by the site geologist). A bentonite pellet, or equivalent, seal (minimum 2-foot thickness) will then be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. The remainder of the boring annulus, from the seal to the ground surface, will then be backfilled with cement/bentonite grout using a tremie pipe. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted tape measure. A monitoring well construction form will be completed for each well. A sample well construction form is included in Appendix B.

All monitoring wells will be constructed of 4-inch I.D. PVC flush-joint riser pipe and flush-joint factory slotted well screen. Well screen slots shall be no larger than 0.02 inches. All well screens will be 10 feet in length. A schematic diagram showing typical well construction details is included in Appendix A.

A 6- to 8-inch diameter protective steel casing equipped with a locking steel cap will be installed around each well. These casings will be grouted a minimum of three feet into the ground and will have at least one drain hole positioned approximately 0.5 feet above the ground surface. A 0.5-foot thick concrete apron measuring 2 feet by 2 feet equipped with 3 steel barrier posts will be constructed equally portioned around the casing of each well. All monitoring well locks will be keyed alike.

The monitoring wells will be developed after installation to remove fine material and sediments from the area around the well screens and to remove drill cuttings and residual fluids from the area around the monitored interval of the boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist. Wells will be developed until water removed is visibly clear of suspended solids or until approved by the field geologist. Wells will not be developed until a minimum of 24 hours has elapsed after installation of the cement/bentonite grout.

4.6.4.6 Groundwater Sampling

Groundwater samples (estimated 10 samples plus 1 duplicate samples) will be collected from all new monitoring wells at the site. Two sampling rounds will be performed; one round during the wet season (March to May) and one round during the dry season (August to October). Groundwater sampling will be conducted in accordance with Halliburton NUS SOP SA-1.1. Prior to obtaining samples, water levels will be measured and the wells will be evaluated using an interface probe for the detection of immiscible phase liquids. Each monitoring well will be purged using a dedicated stainless steel bailer or a non-dedicated suction pump and disposable polyethylene tubing. Three to six well volumes will be purged. Field measurements of pH, temperature, and specific conductance will be taken for each well volume during purging according to NUS SOP SF-1.1: Section 5. Stabilization of the above

parameters is defined as follows: temperature $\pm 1^{\circ}\text{C}$, pH ± 0.2 units, SC ± 5 percent. If these parameters do not stabilize after 3 volumes, up to 6 volumes may be removed, as determined by the field geologist. If the wells are purged dry with fewer than three well volumes removed, the wells will be sampled when the water level in the well recovers to at least 70% of the original capacity, or within 24-hours of purging, whichever is first. The exception to this will be samples to be analyzed for volatile organics. Samples for volatile organics will be collected within 3 hours from the time of well purging.

Dedicated stainless steel bailers with dedicated polypropylene rope as bailing line will be used for sample collection.

All pertinent field data shall be recorded on the appropriate sample log sheet (Appendix B) and in the field log book.

Groundwater samples will be analyzed at a fixed-base laboratory as follows:

Analyze all groundwater samples for TCL volatiles, TCL semivolatiles, and Lead.

Analyze 3 of the 10 groundwater samples (2 samples and 1 duplicate sample) for the following additional engineering parameters: pH, TSS, TDS, Alkalinity, hardness, organic lead, TPH, TOC, BOD, and COD. One sample and a duplicate sample will be collected from a source area or downgradient shallow depth well. One sample will be collected from a source area or downgradient intermediate depth well.

Floating product, if found, will be analyzed for BTU content, organic lead, and pesticides/PCBs

4.6.4.7 Aquifer Testing

A constant rate pumping test will be performed to determine the hydraulic characteristics of the flow system underlying the site. The existing pumping well at the site will be used for this test. Selected existing and newly installed monitoring wells will be used as observation wells during the pumping test. The pumping test will be conducted using either a surface pump or a submersible pump. The pump will be equipped with clean polyethylene discharge hose. The pumping test will be performed as per the general procedures described in Halliburton NUS SOP GH- 2.3 (Appendix A).

The optimum pumping rate will be established by performing a preliminary step-drawdown test. The actual pumping test duration will be determined in the field based on the aquifer response to pumping, with a minimum duration of 12 hours and a maximum duration of 36 hours. Water levels will be periodically measured in the

pumping well and observation wells throughout the duration of the test. Water level recovery measurements will be collected from immediately upon stoppage of pumping until the water level in the pumping well has recovered to approximately 90% of the original (pre-pumping) water level. Water levels will be monitored during pumping and recovery tests using hand measurements and Insitu Hermit data loggers with pressure transducers.

The data will be evaluated using standard analysis techniques. The results of the pumping test will be used to calculate aquifer characteristics, determine groundwater migration rates, in models to predict potential future contaminant concentrations at downgradient locations, and may be used to design groundwater extraction/treatment systems.

4.6.4.8 Water Level Measurement

Two complete rounds of water levels will be collected from the new monitoring wells. Each round of measurements will be taken within a 2-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements will be taken with an electronic water level indicator using a marked or notched location at the top of the PVC well casing as the reference point for determining depths to water. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate field logbook and on water level measurement forms (attached in Appendix B).

4.6.4.9 Site Surveying

The vertical and horizontal location of the corners of soil gas survey grid, temporary groundwater sampling locations, monitoring wells, subsurface soil borings, and surface soil sampling points will be surveyed upon completion of field activities.

Existing survey monuments within NWIRP Calverton may be utilized as reference points. As an alternative, a Global Positioning System (GPS) may be required to establish survey control. Horizontal locations will be surveyed to NWIRP, Calverton coordinates, which can be tied to the New York State Plane Coordinate System.

All horizontal locations will be surveyed to the nearest 0.10 foot. Elevations will be referenced to the 1929 North American Datum. Monitoring well elevations will be surveyed to the nearest 0.01 foot at the ground surface, the top of the PVC riser pipe, and the top of the steel protective casing. Ground surface elevations of other sampling locations will also be surveyed to the nearest 0.01 foot.

4.7 SITE 7 - FUEL DEPOT AREA

4.7.1 Site Background

The fuel depot area is located approximately 3,000 feet north of the south gate, near the geographic center of the Calverton facility (Figure 1-3). It is located at the eastern side of the road leading from the south gate and is approximately 2 acres in area, measuring 150 feet in width and 400 feet in length (Figure 4-11). The principal features of the fuel depot are a large concrete trucking-parking area covering the southern half of the depot, and two underground fuel storage tank areas: a 60- by 120-foot area covering the northeast area of the depot, and a 40- by 150-foot area covering the north-central area. The underground storage tank (UST) areas are primarily soil covered, with scattered concrete pads surrounding fill and vent pipes. A pump house is located at the western edge of the fuel depot, and a maintenance garage is located at the southeastern corner. The area is fully fenced (USGS, 1967; U.S. Department of the Navy, 1986).

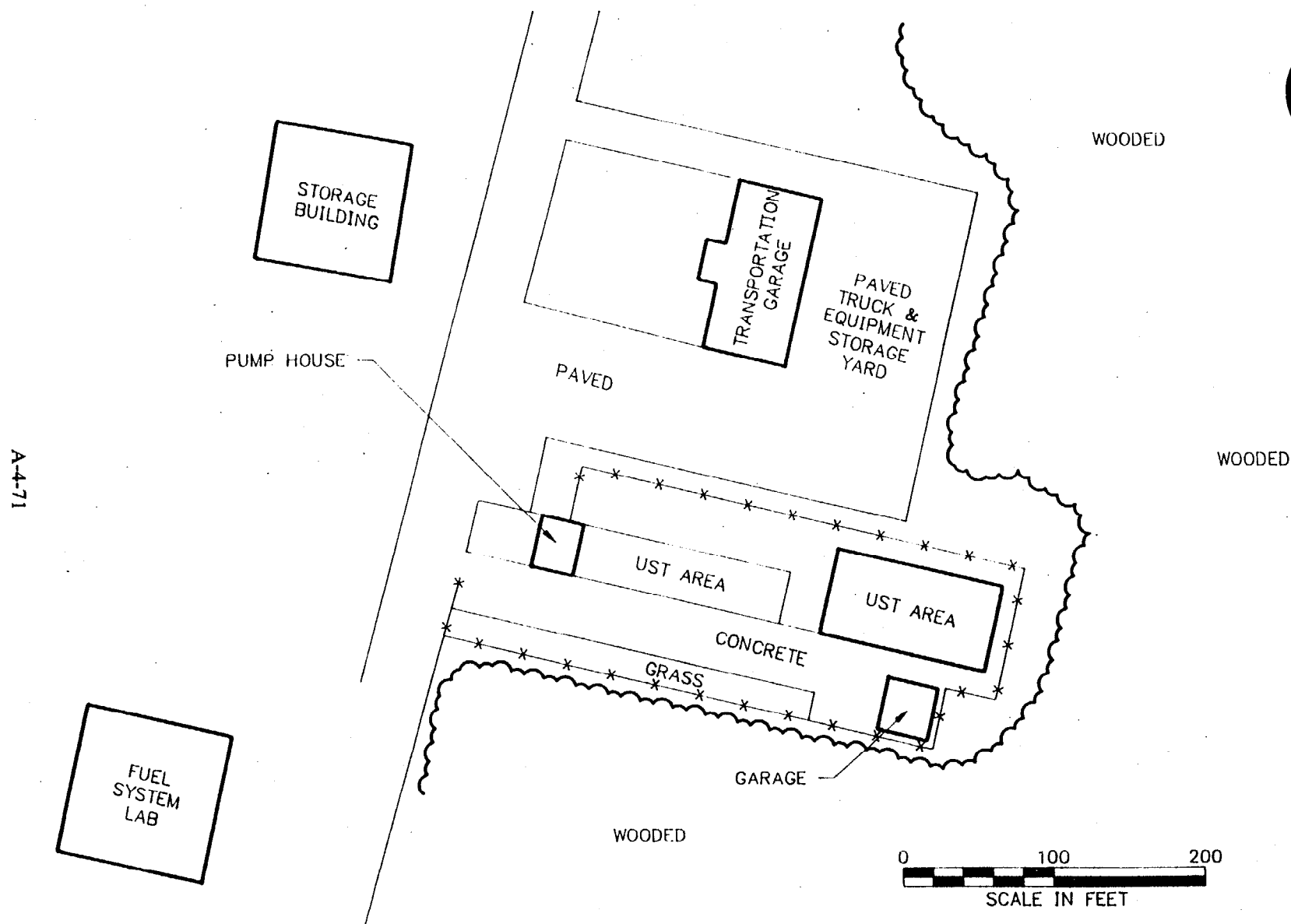
Monitoring wells are located both within the fuel depot area and in the surrounding areas. A total of 34 monitoring wells are located in the area (Navy 1986; MPG, 1990-1991).

A garage and paved parking area for trucks and equipment used by the Grumman transportation department are located north of the fuel depot. Areas to the east and south are wooded. A paved roadway leading from the south gate is adjacent to the depot to the west; a storage building and the fuel system laboratory building are located west of the road (USGS, 1967; Navy, 1986). The fuel depot is generally level, with a very slight slope to the east (USGS, 1987).

4.7.2 Site Specific History

The fuel depot area is used for the storage and distribution of fuel products, such as JP-4 and JP-5 jet fuel at the facility. Fuels are stored in underground storage tanks. The material is then transferred to trucks for use in the flight preparation areas of the facility. These activities have resulted in groundwater contamination by fuels, which may have occurred by tank and pipe leakage, overfilling, and spills (Navy, 1986; Ohlman, 1985).

The remedial activities at the fuel depot area to date were limited to the identification of the dissolved product plume. A total of 34 monitoring wells were installed by MPC in this area, the latest one in May 1989. No remediation of soils, free product, or groundwater is known to have occurred at this site.



SITE LAYOUT MAP
SITE 7 - FUEL DEPOT AREA
NWIRP, CALVERTON, NEW YORK

FIGURE 4-11

4.7.3 Sampling Rational

The Fuel Depot area is being investigated to fully delineate the nature and extent of contamination in soils, and groundwater as the result of leaking USTs or fuel spills at the site. Samples collected during the SI indicated minor soils and significant groundwater contamination (see Section 4.1.5). Sampling activities for the RFI will focus on identifying the extent of soils and groundwater contamination in the area surrounding the USTs due to leaking tanks and/or fuel spills at the site.

4.7.4 Sampling Activities

The field investigation at Site 7 will consist of the following tasks:

- Soil Gas Survey
- Subsurface Soil Borings and Subsurface Soil Sampling
- Temporary Well/Groundwater Sampling
- Permanent Monitoring Well Installation
- Groundwater Sampling - (permanent monitoring wells)
- Aquifer Testing
- Water Level Measurement
- Site Surveying

Soil, waste, groundwater, and surface water samples will be collected in accordance with NEESA methodology. Table 1-4 provides a summary of the chemical sampling program for the site. A summary list of all analytes, analytical methods, contract required quantitation limits, containers, preservatives, and holding times is provided on Table 3-1. A site specific summary of field activities, sampling, and sample analyses is presented in Table 4-5.

4.7.4.1 Soil Gas Survey

A contaminant-specific soil gas survey will be conducted at the Fuel Depot Area in suspected areas of soil and groundwater contamination (Figure 4-12). This is a field screening activity designed to delineate the extent of soil gas contamination and to help to focus the subsurface soil and groundwater investigation. The soil gas survey will be conducted across the source area and to the south and east of the site (downgradient of the site).

An initial survey area with 100-foot grid spacings (approximately 15 locations) will be used to cover the source area of suspected soil and groundwater contamination (Figure 4-12). An additional 20 optional locations are proposed

TABLE 4-5

**SITE 7 - FUEL DEPOT AREA - FIELD ACTIVITIES
RFI WORK PLAN
NWIRP CALVERTON, LONG ISLAND, NEW YORK
(SEE TABLE 1-4 FOR ADDITIONAL DETAIL)**

TASK	DESCRIPTION OF ACTIVITIES	ANALYSIS¹
Subsurface Soil Boring/Sampling	4 subsurface soil borings; 2-3 samples/boring	TCL volatiles, TCL semivolatiles, lead, and engineering parameters ²
Permanent Monitoring Well Installation/Groundwater Sampling	6 shallow depth and 4 intermediate depth monitoring wells installed; 2 rounds of groundwater samples; free product sampling if found	TCL volatiles, TCL semivolatiles, lead, and engineering parameters ³ ; BTU content, organic lead, and PCB/pesticides if free product found
Temporary Monitoring Well Installation/Groundwater Sampling	15 locations; 2 samples/location (2 depths)	Selected volatile organics (on- and offsite analyses)
Soil Gas Sampling	35 soil gas survey locations; 2 samples/location (2 depths)	Selected volatile organics (onsite analysis)

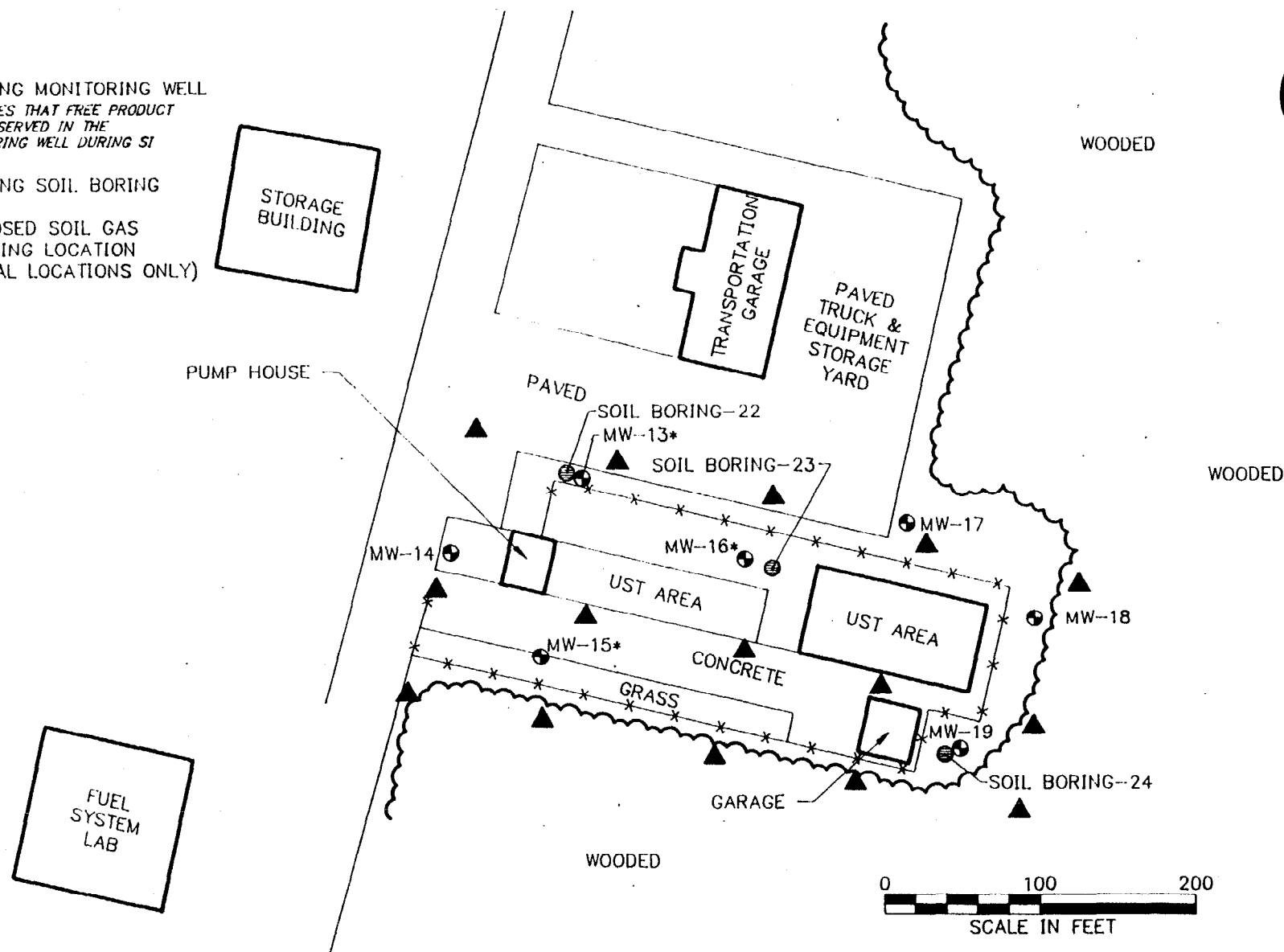
1 - See Table 1-1 for breakdown of analytes per sample.

2 - Engineering parameters include particle size, bulk density, moisture content, TOC, TPH, BTU content, TCLP characterization, permeability, and organic lead.

3 - Engineering parameters include temperature, pH, TSS, TDS, Alkalinity, hardness, TOC, BOD, COD, and organic lead.

LEGEND

- ⊕ EXISTING MONITORING WELL
- * INDICATES THAT FREE PRODUCT WAS OBSERVED IN THE MONITORING WELL DURING SI
- EXISTING SOIL BORING
- ▲ PROPOSED SOIL GAS SAMPLING LOCATION (INITIAL LOCATIONS ONLY)



PROPOSED SOIL GAS SAMPLING LOCATIONS
SITE 7 - FUEL DEPOT AREA
NWIRP, CALVERTON, NEW YORK

FIGURE 4-12

to refine the initial survey area and to cover areas extending to the outward and downgradient of the initial survey area. Optional locations may be located adjacent to initial survey points with positive soil gas detections to define the extent of soil gas contamination. In suspected areas outside of the source area (downgradient), secondary sampling locations will be gridded with a 200-foot spacing extending outward from the source area grid.

The results of the soil gas survey will be used to define smaller areas of potential soil and/or groundwater contamination that will be further investigated using soil borings and temporary monitoring wells.

Soil gas samples will be collected from two depths at each sampling location (70 total samples): one approximately 3-5 ft below ground surface (bgs), and one just above the water table (approximately 10-12 feet bgs). Analyses of soil gas samples for selected volatile organic compounds will be conducted onsite as before using a mobile GC for quick turn around of results.

Each potential soil gas sampling location will be marked with a surveyor's pin flag. Groundwater is estimated to lie between approximately 5 and 20 feet below ground surface (bgs) at the NWIRP, Calverton. Soil gas samples will be collected by driving a steel sampling probe into the ground to the desired sampling depth. The drive point on the probe is slotted to allow soil gas to flow through the sampling probe. The sampling probe will be evacuated with sample prior to collection the soil gas sample. The soil gas sample will be collected into an air sample bag from a dedicated inert sampling tube that connects the steel probe to a pump. Decontamination of steel sampling equipment will be performed as described in Section 4.11.

Prior to soil gas sample collection, a gas chromatograph compound library will be established using certified gas standards for the following target compounds:

Benzene	Ethylbenzene
1,1-dichloroethene (DCE)	c-1,2-DCE
t-1,2-DCE	1,1-dichloroethane (DCA)
Trichloroethene (TCE)	Tetrachloroethene (PCE)
1,1,1 trichloroethane (TCA)	1,1,2-TCA
Chloroform	Carbon tetrachloride
Toluene	Total (m-, p-, and o-,) xylenes
Methylene chloride	Freon-113

4.7.4.2 Soil Borings and Subsurface Soil Sampling

Four subsurface soil borings will be drilled at locations based on the results of the soil gas survey. The 4 borings will investigate the nature and extent of subsurface soil contamination at the site, and the potential downward migration of contamination into underlying soils and groundwater. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A).

Subsurface soil borings will be drilled to the water table (approximately 12 feet bgs) using hollow stem auger drilling techniques. During drilling operations, Standard Penetration Tests and split-spoon sampling for lithologic description will be performed continuously in all soil borings. All split-spoon samples will be screened with an Organic Vapor Analyzer (OVA) and visually inspected for lithologic description. The split spoon samplers will have a minimum outside diameter of 2 inches and be at least 2 feet long to fulfill the sample volume requirements for chemical analysis. Three-inch diameter split spoons will be used to collect samples that require additional volume (e.g. duplicate samples). The use of drilling fluids is prohibited during soil boring activities. Soil borings will be backfilled to the surface using drill cuttings. Soil boring locations will be marked with a wooden stake for future reference. A complete log of each boring will be maintained by the field geologist. Appendix B contains an example of the boring log form. At a minimum, the boring log will contain the following information, when applicable, for each overburden boring:

Sample numbers and types

Sample depths

Standard Penetration Test data

Sample recovery/sample interval

Soil density or cohesiveness

Soil color

Unified Soil Classification System (USCS) material description and symbol

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling method, and total depth of each borehole should be included on each boring log, as well as any other pertinent observations. Sample bottles containing soil samples collected solely for lithologic description will be numbered consecutively starting with S-1. In addition, the following information shall be recorded on the lid of the sample jars:

Job number and name

Boring and sample number

Date
Depth interval
Blow counts

As an alternative to obtaining samples with hollow stem augers, during the subcontractor procurement process, alternative sample collection techniques will be considered. One potential alternative is the "direct push" method of obtaining samples. Under this method, the samples are collected by hydraulically driving a 1-inch diameter piston-type sampler to the top of the desired sample interval; the piston within the sampler is released and the pipe advanced through the target interval. The soil core then enters the sampler, which contains a non-reactive plastic or stainless steel liner. After the drive rod is removed from the soil, the liner containing the soil column can be removed.

Two to three (2-3) samples will be collected for chemical analysis from each of the 4 borings (approximately 10 samples plus 1 duplicate sample)(Table 4-5). In each boring, one sample for chemical analysis will be collected from immediately above the soil/water interface. Additional samples for chemical analysis, from shallower depths in each boring, will be collected based on elevated OVA readings and visual observation of contamination (stained soils, etc...). Exact sampled intervals will be determined in the field.

Samples for chemical analysis will be collected by splitting the soil sample open longitudinally and extracting soil from the entire length of the interior of the sample. Portions of the sample submitted for TCL Volatiles analysis (when collected) will be placed directly into the required containers. Remaining portions of the sample will be homogenized and distributed to the appropriate containers. A stainless steel trowel will be used to place the sample into the required containers. Drilling and sampling will be performed in accordance with Halliburton NUS SOPs GH-1.3 and GH-1.5 (Appendix A). Decontamination of drilling and sampling equipment will be performed as described in Section 4.0.

Soil samples collected from the subsurface soil borings will be submitted to a fixed base laboratory for chemical analysis as follows:

All soil samples will be analyzed for TCL volatiles, TCL semivolatiles, and Lead.

1 of the 10 samples will also be analyzed for the following additional engineering parameters: particle size, bulk density, moisture content, permeability, TOC, TPH, BOD, COD, BTU content, organic lead, and TCLP characterization.

4.7.4.3 Temporary Well/Groundwater Sampling

Approximately 30 groundwater samples at 15 locations will be collected from temporary monitoring wells. The temporary monitoring wells may consist of well screen temporarily installed in a subsurface soil boring, a drive point, or a geoprobe/hydropunch-type sample point. Samples will be collected at two depths: one at the water table and one approximately 20-30 ft below the water table. Samples may be analyzed onsite for a suite of volatile organic compounds using a mobile GC for quick turn around. Ten percent (10%) of these samples will be sent to an offsite fixed base laboratory for chemical analysis to confirm the results of the field based analysis. The results of the soil gas survey will be used to delineate areas of potential groundwater contamination. Initial temporary well/groundwater sampling locations will be based on a grid pattern (approximately 50-foot spacing) across the area of suspected groundwater contamination defined by the soil gas survey. Secondary sampling locations will be located based on the results of the analytical results of the initial sampling and will be designated to define the extent of groundwater contamination.

4.7.4.4 Permanent Monitoring Well Installation

Permanent monitoring wells will be installed based on the results of the soil gas survey, soil borings, and field-based groundwater sampling and analysis activities described above. It is expected that 10 permanent monitoring wells will be installed as follows:

- 6 shallow depth wells
 - 1 upgradient well
 - 2 wells near or in the source area
 - 3 downgradient wells
- 4 intermediate wells (paired to shallow depth wells)
 - 1 upgradient well
 - 1 source area well
 - 2 downgradient wells

Monitoring well drilling and installation activities will be conducted as per Halliburton NUS SOP GH-1.3, GH-1.5, and GH-1.7. Boring logs will be completed as described in section 4.5.4.4. Boring logs will be completed and as described in Section 4.5.4.4. Boring logs will be completed and as described in Section 4.5.4.4.

Shallow depth well borings will be drilled using hollow stem auger drilling techniques. Split spoon samples for lithologic description will be collected continuously to the water table and every 5 ft below the water table to the

total depth of the boring. Subsurface soil samples for chemical analysis will not be collected from monitoring well borings. In shallow depth wells, the top of the screened interval will be positioned approximately 2 feet above the depth that water is encountered during drilling.

Intermediate depth wells will be installed to approximately 80 ft bgs to help determine the vertical extent of groundwater contamination. These wells will be located approximately 10-20 ft from shallow depth wells to form shallow/intermediate depth well pairs. Intermediate depth well borings will also be advanced using hollow stem auger drilling techniques. If this method proves unsuccessful, alternative drilling techniques (mud rotary, and/or reverse circulation drilling) may be employed. Subsurface soil samples for chemical analysis will not be collected from intermediate depth monitoring well borings. Intermediate depth well borings will be geophysically logged (gamma-ray log) from the water table to the total depth of the boring and split spoon samples for lithologic description will be collected every 10 ft.

After the monitoring well borings are drilled to the desired depth (8-inch minimum diameter boring), the well screen and riser pipe will be installed through the augers (if used) to the desired depth. The annulus of the boring around the well screen, and 2 to 3 feet above the well screen, will be backfilled with clean silica sand (No. 20 to 30 U.S. Standard Sieve size or as determined by the site geologist). A bentonite pellet, or equivalent, seal (minimum 2-foot thickness) will then be installed above the sand pack and allowed to hydrate as per the manufacturer's recommendations. The remainder of the boring annulus, from the seal to the ground surface, will then be backfilled with cement/bentonite grout using a tremie pipe. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted tape measure. A monitoring well construction form will be completed for each well. A sample well construction form is included in Appendix B.

All monitoring wells will be constructed of 4-inch I.D. PVC flush-joint riser pipe and flush-joint factory slotted well screen. Well screen slots shall be no larger than 0.02 inches. All well screens will be 10 feet in length. A schematic diagram showing typical well construction details is included in Appendix A.

A 6- to 8-inch diameter protective steel casing equipped with a locking steel cap will be installed around each well. These casings will be grouted a minimum of three feet into the ground and will have at least one drain hole positioned approximately 0.5 feet above the ground surface. A 0.5-foot thick concrete apron measuring 2 feet by 2 feet equipped with 3 barrier posts will be constructed equally portioned around the casing of each well. All monitoring well locks will be keyed alike.

The monitoring wells will be developed after installation to remove fine material and sediments from the area around the well screens and to remove drill cuttings and residual fluids from the area around the monitored interval of the

boring. Wells will be developed by air lift, bailing and surging, or by pumping, as determined by the field geologist. Wells will be developed until water removed is visibly clear of suspended solids or until approved by the field geologist. Wells will not be developed until a minimum of 24 hours has elapsed after installation of the cement/bentonite grout.

4.7.4.5 Groundwater Sampling

Groundwater samples (estimated 10 samples plus 1 duplicate samples) will be collected from all new monitoring wells at the site. Two rounds of sampling will be performed; one round during the dry season and one round during the wet season. Groundwater sampling will be conducted in accordance with Halliburton NUS SOP SA-1.1. Prior to obtaining samples, water levels will be measured and the wells will be evaluated using an interface probe for the detection of immiscible phase liquids. Each monitoring well will be purged using a dedicated stainless steel bailer or a non-dedicated suction pump with disposable polyethylene tubing. Three to six well volumes will be purged. Field measurements of pH, temperature, and specific conductance will be taken for each well volume during purging according to NUS SOP SF-1.1: Section 5. Stabilization of the above parameters is defined as follows: temperature $\pm 1^{\circ}\text{C}$, pH ± 0.2 units, SC ± 5 percent. If these parameters do not stabilize after 3 volumes, up to 6 volumes may be removed, as determined by the field geologist. If the wells are purged dry with fewer than three well volumes removed, the wells will be sampled when the water level in the well recovers to at least 70% of the original capacity, or within 24-hours of purging, whichever is first. The exception to this will be samples to be analyzed for volatile organics. Samples for volatile organics will be collected within 3 hours from the time of well purging.

Dedicated stainless steel bailers with dedicated polypropylene rope as bailing line will be used for sample collection.

All pertinent field data shall be recorded on the appropriate sample log sheet (Appendix B) and in the field log book.

Groundwater samples will be analyzed at a fixed-base laboratory as follows:

Analyze all groundwater samples for TCL volatiles, TCL semivolatiles, and Lead.

Analyze 3 of the 10 groundwater samples (2 samples and 1 duplicate sample) for the following additional engineering parameters: pH, TSS, TDS, Alkalinity, hardness, organic lead, TPH, TOC, BOD, and COD. One sample and a duplicate sample will be collected from a source area or downgradient shallow depth well. One sample will be collected from a source area or downgradient intermediate depth well.

Floating product, if found, will be analyzed for BTU content, organic lead, and pesticides/PCBs

4.7.4.6 Aquifer Testing

A slug test will be performed on one shallow depth well, and one intermediate depth well (if installed) to determine the hydraulic characteristics of the alluvial aquifer at the site. Both rising head and falling head tests will be performed by either inserting a solid slug into the well to raise water levels, then measuring the rate of decline in water level (recovery), or by removing a slug of water and measuring the rate of rise of water level back to equilibrium. Slug test data will be collected using an Insitu Hermit data logger with transducer, and Insitu Levelhead with transducer, and/or and electronic water level indicator. Results of the slug tests will be used to calculate values of hydraulic conductivity.

4.7.4.7 Water Level Measurement

Two complete rounds of water levels will be collected from the new monitoring wells. Each round of measurements will be taken within a 2-hour period of consistent weather conditions to minimize atmospheric/precipitation effects on groundwater levels. Measurements will be taken with an electronic water level indicator using a marked or notched location at the top of the PVC well casing as the reference point for determining depths to water. Water-level measurements will be recorded to the nearest 0.01 foot in the appropriate field logbook and on water level measurement forms (attached in Appendix B).

4.7.4.8 Site Surveying

The vertical and horizontal location of the corners of soil gas survey grid, temporary groundwater sampling locations, monitoring wells, subsurface soil borings, and surface soil sampling points will be surveyed upon completion of field activities.

Existing survey monuments within NWIRP Calverton may be utilized as reference points. As an alternative, a Global Positioning System (GPS) may be required to establish survey control. Horizontal locations will be surveyed to NWIRP, Calverton coordinates, which can be tied to the New York State Plane Coordinate System.

All horizontal locations will be surveyed to the nearest 0.10 foot. Elevations will be referenced to the 1929 North American Datum. Monitoring well elevations will be surveyed to the nearest 0.01 foot at the ground surface, the top of the PVC riser pipe, and the top of the steel protective casing. Ground surface elevations of other sampling locations will also be surveyed to the nearest 0.01 foot.

4.8 SAMPLE IDENTIFICATION SYSTEM

Each sample submitted to a fixed base laboratory for chemical analysis will be assigned a unique sample tracking number. The sample tracking number will consist of a four-segment, alpha-numeric code that identifies the site (plus building number), sample medium and location, and sample depth (in the case of soil and sediment samples). QA sample designations will be blind relative to sample duplicates.

Any other pertinent information regarding sample identification will be recorded in the field log books and sample log sheets.

The alpha-numeric coding to be used in the sample system is explained below.

Field Samples

(AA) - (AANN) - (NNN)

(Site name) (Medium & Location) (Sample identifier)

QA Samples

(AA) - (AA) - (AA) - (NN)

(Site name) (Medium) (QA type) (Number)

Character Type:

A = Alpha

N = Numeric

Site name:

NP = Northeast Pond Disposal Area

FT = Fire Training Area

FC = Fuel Calibration Area

FD = Fuel Depot Area

Medium:

GW = Groundwater from a permanent monitoring well

SB = Subsurface Soil from soil boring

ST = Subsurface Soil from a test pit

WS = Waste

SW = Surface water

SD = Sediment

SS = Surface Soil

Sample Location:

Subsurface soil or waste = soil boring or test pit number (i.e. 01, 02, 03...)

Surface water or Sediment = sample location number (i.e. 01, 02, 03...)

Groundwater = well number

Sample Identifier:

For subsurface, waste, soil, and sediment samples = Start depth (in feet, of sample).

Not used for groundwater, surface water or surface soil samples.

QA Sample Designation:

DU = Duplicate

RB = Equipment Rinsate Blank

FB = Field Blank

TB = Trip Blank

Matrix Spike and Matrix Spike Duplicate (MS/MSD) samples will be designated on the field documentation forms and sample labels.

For example, a subsurface soil sample and its duplicate (with the duplicate being the third obtained during the sampling activities) from soil boring number 04 at the Northeast Pond Disposal Area at a depth of 10 to 12 feet would be:

NP-SB04-10.0, and

DU-03

4.9 SAMPLING EQUIPMENT AND PROTOCOLS

The sampling equipment and protocols to be used are presented in Appendix A and are Halliburton NUS Standard Operating Procedures.

4.10 SAMPLE HANDLING

Sample handling includes the field-related considerations regarding the selection of sample containers, preservatives, allowable holding times and analyses requested. Table 3-1 summarizes the sample handling considerations for this field investigation. The EPA User's Guide to the Contract Laboratory Program (EPA, December 1988), and the Federal Register (EPA, October 26, 1984) address the topics of containers and sample preservations.

4.10.1 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with Halliburton NUS SOP SA-6.2 (Appendix A). The FOL will be responsible for completion of the following forms:

- Sample Labels
- Chain-of-Custody Forms
- Appropriate labels applied to shipping coolers
- Chain-of-Custody Labels
- Federal Express Air Bills

4.10.2 Sample Custody

Custody of samples must be maintained and documented at all times. Chain-of-custody begins with the collection of the samples in the field. Section 5.3 of Halliburton NUS SOP SA-6.1 (Appendix A) provides a description of the chain-of-custody procedures to be followed. A sample chain-of-custody form is attached in Appendix B.

4.11 EQUIPMENT DECONTAMINATION

The equipment involved in field sampling activities will be decontaminated prior to and during drilling and sampling activities. This equipment includes soil gas probes, drilling rigs, downhole tools, augers, backhoes, well casing and screens, and all sampling equipment.

4.11.1 Major Equipment

The backhoe bucket, downhole drilling or soil gas equipment, and sampling tools shall be steam cleaned prior to beginning work, between test pits, well borings, soil gas points, any time the drilling rig leaves the site prior to completing a boring, and at the completion of the drilling program.

These decontamination operations will consist of washing the equipment using a high-pressure steam wash. All decontamination activities will take place on a decontamination pad at a location determined during mobilization. It is assumed that the facility will provide a suitable location for decontamination operations along with potable water and electricity. Additional requirements for drilling equipment decontamination can be found in Halliburton NUS SOP SA-7.1: Section 5 (Appendix A).

4.11.2 Sampling Equipment

All sampling equipment used for collecting samples will be decontaminated both prior to beginning field sampling and between samples. The following decontamination steps will be taken:

- Potable water rinse
- Alconox or liquinox detergent wash
- Potable water rinse
- Nitric acid rinse (for carbon steel equipment used on TAL metals samples only)
- Steam distilled water rinse (for carbon steel equipment used on TAL metal samples only)
- Methanol rinse
- Hexane rinse (pesticide grade) (only necessary for equipment used on pesticide/PCB samples)
- Steam distilled water rinse
- Air dry
- Wrap in aluminum foil for transport.

Field analytical equipment such as pH, conductivity and temperature instrument probes will be rinsed first with steam distilled water, then with the sample liquid.

4.12 RESIDUE MANAGEMENT

Five types of potentially contaminated residues are expected to be generated during this field investigation, namely Personal Protection Equipment (PPE), drill rig decontamination fluids, sampling equipment decontamination fluids, auger soil cuttings, and purge and pumping test waters. Based on the activities and types of contaminants present, none of these residues are expected to represent a significant risk to human health or the environment if properly managed. Planned management of each of these residues is provided below.

PPE - PPE will be placed in the trash receptacles at the facility.

Drill Rig Decontamination Fluids - Drill rig decontamination fluids will be containerized in 55-gallon drums and stored at the fire training area. Pending the results of the RFI testing, these decontamination fluids will be discharged to the onsite wastewater treatment plant.

Sampling Equipment Decontamination Fluids - Equipment decontamination fluids will be containerized and handled with the drill rig decontamination fluids.

Auger Soil Cuttings - Auger soil cuttings will be screened with an OVA. If OVA readings are detected above background levels or discoloration of the soils is noted, then the cuttings will be containerized in 55-gallon drums and stored at the fire training area for additional testing. Otherwise, the cuttings will be used to backfill soil borings, or spread at the site if generated from monitoring well borings.

Purge and Pumping Test Water - Groundwater generated during monitoring well sampling and pumping test activities will be screened with an OVA. Fluids with elevated OVA readings (greater than 1 ppm) will be containerized with the drill rig decontamination fluids. Fluids without elevated OVA readings will be discharged to the surfaces at the site.

5.0 DOCUMENTATION AND CHAIN-OF CUSTODY

Sample custody procedures are designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. An example of the chain-of-custody form, which will be used during this investigation, is included in Appendix B.

Samples collected during the site investigation will be the responsibility of identified persons from the time they are collected until they, or their derived data, are incorporated into the final report. Stringent chain-of-custody procedures will be followed to document sample possession.

5.1 FIELD CUSTODY

- The FOL, or his or her designee, is responsible for the care and custody of the samples collected until they are delivered to the analyzing laboratory or entrusted to a carrier.
- Sample logs or other records will always be signed and dated.
- Chain-of-custody sample forms will be completed to the fullest extent possible prior to sample shipment. They will include the following information: project name, sample number, time collected, source of sample and location, description of sample location, matrix, type of sample, grab or composite designation, preservative, number and size of bottle, analysis, and name of sampler.

These forms will be filled out in a legible manner, using waterproof ink, and will be signed by the sampler. Similar information will be provided on the sample label which will be securely attached to the sample bottle. The label will also include the general analyses to be conducted. In addition, sampling forms will be used to document collection, filtration, and preparation procedures. Copies of all field documentation forms are provided in Appendix B.

5.2 TRANSFER OF CUSTODY AND SHIPMENT

The following procedures will be used when transferring custody of samples:

- Samples will always be accompanied by a chain-of-custody record. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time of the chain-of-custody record. This record documents the sample custody transfer from the sampler to the laboratory, often through another person or agency (common carrier). Upon arrival at the laboratory, internal sample custody procedures will be followed.
- Prior to shipment to the laboratory for analysis, samples will be properly packaged. Individual custody records will accompany each shipment. Shipping containers will then be sealed for shipment to the laboratory. The methods of shipment, courier name, and other pertinent information, will be entered in the remarks section of the custody record.
- All shipments will be accompanied by the chain-of-custody record identifying the contents. The original record will accompany the shipment; and a copy will be retained by the field sampler.
- Proper documentation will be maintained for shipments by common carrier.

5.3 SAMPLE SHIPMENT PROCEDURES

The following procedures will be followed when shipping samples for laboratory analysis:

- Samples requiring refrigeration will be promptly chilled with ice or Blue Ice to a temperature of 4°C and will be packaged in an insulated cooler for transport to the laboratory. Ice will be sealed in containers to prevent leakage of water. Samples will not be frozen.
- Only shipping containers that meet all applicable state and Federal standards for safe shipment will be used.
- Shipping containers will be sealed with nylon strapping tape, custody seals will be signed, dated, and affixed, in a manner that will allow the receiver to quickly identify any tampering that may have occurred during transport to the laboratory.

- Shipment will be made by overnight courier. After samples have been taken, they must be sent to the laboratory within 24 hours.

5.4 FIELD DOCUMENTATION RESPONSIBILITIES

It will be the responsibility of the FOL to secure all documents produced in the field (geologist's daily logs, lithologic and sampling logs, communications) at the end of each work day.

The possession of all records will be documented; however, only the project FOL or designee may remove field data from the site for reduction and evaluation.

The data generated by the laboratory will be sent to Halliburton NUS, validated, and stored by Halliburton NUS until completion and acceptance of the RFI investigation reports. A final QC data report will be issued to the NCR at least 3 weeks before the final report is issued.

6.0 CALIBRATION PROCEDURES

Field equipment such as the portable gas chromatograph (GC), the Organic Volatile Analyzer (OVA), the pH and specific conductance meters, and any geophysical equipment used during this project will be calibrated and operated in accordance with the manufacturer's instructions and manuals. A log will be kept documenting the calibration results for each field instrument. The log will include the date, standards, personnel, and results of the calibration.

Calibration procedures for laboratory equipment used in the analysis of environmental samples will be performed in accordance with CLP requirements.

7.0 SAMPLE PREPARATION AND ANALYTICAL PROCEDURES

Environmental samples collected during the field investigation for chemical analyses will be analyzed using the appropriate analytical procedures as outlined in Table 3-1 of this work plan. The methods are referenced to the appropriate CLP, EPA, or other guidance.

8.0 DATA REDUCTION, VALIDATION, AND REPORTING

Data reduction, validation, and reporting are basic steps in the control and processing of field and laboratory project-generated data. Data will be presented in tabular form with site background result (for inorganics) and relevant requirements for organic results used as screening criteria. Data validation procedures are described below.

Data validation consists of a stringent review of an analytical chemical data package with respect to sample receipt and handling, analytical methods, data reporting and deliverables, and document control. The quality of data generated by a laboratory is extremely important; it is an integral part of the investigation and should be clearly tied to the project goals. Data used to develop qualitative trends, for example, will not have the same data validation requirements as data used for litigation purposes.

A qualified Halliburton NUS chemist will evaluate the analytical data package using EPA procedures (i.e. the National Functional Guidelines for Evaluating Analytical Data). After the data is validated, a listing of non-conformities will be generated and used to determine whether the data can be utilized for its intended purpose (assessment, enforcement, litigation). Non-conformities yield data qualifiers, which are used to alert the data user to inaccurate or imprecise data. For example, if the calibration criteria are not met, the data reviewer must qualify all affected positive results as estimated and all affected sample quantitation limits as directed in the National Functional Guidelines (NFGs). For situations in which there are several quality control criteria out of specification with regard to method-specific quality control criteria, the quality control criteria outlined in the NFGs and/or the quality control criteria stipulated in the Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program (20.2-047B; 6/88), the data validator may make professional judgments and/or comments on the validity of the overall data package. In situations where the validity of an entire data package is in question, it may be necessary for the sample(s) to be re-analyzed. As a component of the data validation process, the validator will generate a technical memorandum presenting changes in the data, if necessary, and the rationale for making such changes.

The net result is a data package that has been carefully reviewed for its adherence to prescribed requirements and is suitable for its intended use. Data validation thus plays a major role in determining the confidence with which key technical evaluations may be made.

A QC data report shall be sent to the NCR at least 3 weeks before issuance of the final report. For Level D QC, a subset of data from the CLP data packages shall be submitted. For 20 percent of the water samples and 20

percent of the soil samples, the subcontractor shall submit the full CLP package. The report shall indicate the duration and location of storage for all raw data, QC charts, corrective action, sample lists, COC information, notebooks, work sheets, automated data processing system output, and calibration.

The final report, which shall be reviewed by the NCR prior to its release, will include a data summary. The summary of analytical data will exclude non-detected compounds. No subtraction of blank contaminants will be allowed; data will be flagged if associated blank contamination occurs. All data flags will follow the result in the summary.

The final report will also include a QC summary section. The QC summary will discuss flagged data, matrix spikes/spike duplicates, control charts, laboratory duplicates, surrogate spike recoveries, holding times, field blanks, trip blanks, rinsates, field duplicates, precision, accuracy, and completeness.

The laboratory data for each sample will be reported in an appendix. These data will be presented in a spreadsheet format with all trip, field, and rinsate blanks marked. The format recommended by NEESA will be used.

Field logs and forms will be included in another appendix. Another appendix will include method blank spike control charts, surrogate recoveries, matrix spike and duplicate, field, and laboratory duplicates for all spike samples.

9.0 INTERNAL QUALITY CONTROL CHECKS

Quality control samples generated by Halliburton NUS will include the collection of field duplicates, the preparation of field blanks and rinsate blanks, and the use of laboratory-prepared trip blanks. An approximate 10 percent duplication - one per 10 samples or one per sample matrix if less than 10 samples are collected (see Table 3-1) of soil, sediment, surface water/groundwater samples will be used to monitor the laboratory's performance.

Trip blanks (volatiles only) will be shipped along with the sample bottles and will be analyzed concurrently with the collected environmental samples. These trip blanks will be submitted at a rate of one per sample shipment of samples for TCL volatile analysis. Rinsates, prepared by running distilled water through the sampling equipment, will be analyzed to determine whether the decontamination procedures may be biasing the data. Field blanks will be prepared at a rate of one per source per event.

There are two types of quality assurance mechanisms used to ensure the production of analytical data of known and documented quality. The internal laboratory quality control procedures for the analytical services are specified in the CLP protocol and Table 3-1. These specifications include the types of control samples required (sample spikes, surrogate spikes, controls, and blanks), the frequency of each control, the compounds to be used for sample spikes and surrogate spikes, and the quality control acceptance criteria. It will be the laboratory's responsibility to document, in each data package, that both initial and on-going instrument and analytical QC criteria are met.

Analytical results of field-collected quality control samples will also be compared to acceptance criteria, and documentation will be performed showing that criteria have been met. Any samples in nonconformance with the QC criteria will be identified and reanalyzed by the laboratory, as required. The following procedures will be employed for the processing of NWIRP Calverton samples:

- Proper storage of samples.
- Use of qualified and/or certified technicians.
- Use of calibrated equipment traceable to the CLP Protocol.
- Formal independent confirmation of all computation and reduction of laboratory data and results.
- Use of standardized test procedures.
- Inclusion of duplicate samples at a frequency of one replicate per 10 samples or one per sample matrix if less than 20 samples are collected.

10.0 PERFORMANCE AND SYSTEM AUDITS

System audits will be performed on a semi-continuous basis, as appropriate, to assure that the work is being implemented in accordance with the approved project SOPs and in an overall satisfactory manner.

- The FOL will supervise and check on a daily basis that the soil borings are installed correctly, field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and the field work is accurately and neatly documented.
- The data validator will review (on a timely basis) the data packages submitted by the laboratory. The data validator will check that the data was obtained through the approved methodology, that the appropriate level of QC effort and reporting was conducted, that holding times were met, and that the results are in conformance with the applicable QC criteria. On the basis of these factors, the data validator will evaluate the data quality and limitations.
- The project manager will oversee the FOL and data validator, and check that management of the acquired data proceeds in an organized and expeditious manner.
- System audits for the laboratory are performed on a regular basis.

A formal audit of the field sampling procedures may be conducted in addition to the auditing that is an inherent part of the daily project activities. If so conducted, the auditors will check that sample collection, sample handling, decontamination protocols, and instrument calibration and use are in accordance with the approved project SOPs. The auditors will also check that the field documentation logs and chain-of-custody forms are being filled out properly.

Performance audits of laboratories participating in the CLP are performed quarterly in accordance with the procedures and frequencies established by the CLP.

11.0 PREVENTATIVE MAINTENANCE

Halliburton NUS has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed. This program consists of the following elements:

- The equipment manager keeps an inventory of the equipment in terms of items (model and serial number) quantity and condition. Each item of equipment is signed out when in use, and its operating condition and cleanliness checked upon return.
- The equipment manager conducts routine checks on the status of equipment and is responsible for the stocking of spare parts and equipment readiness.
- The equipment manager maintains the equipment manual library and trains field personnel in the proper use and care of equipment.
- The FOL is responsible for working with the equipment manager to make sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions before being taken to the job site.

The laboratory follows a well-defined program to prevent the failure of laboratory equipment and instrumentation. This preventative program, includes the periodic inspection, lubrication, cleaning, and replacement of parts of the equipment.

12.0 DATA ASSESSMENT PROCEDURES

12.1 REPRESENTATIVENESS, ACCURACY, AND PRECISION

All data generated in the investigation will be assessed for its representativeness, accuracy, and precision. The completeness of the data will also be assessed by comparing the valid acquired data to the project objectives to see that these objectives are being addressed and met. The specific procedures used to determine data precision, accuracy, and completeness will be provided in the analytical reports. Accuracy will be determined using laboratory spiked samples and laboratory field blanks.

The representativeness of the data will be assessed by determining if the data are consistent with known or anticipated hydrogeologic or chemical conditions and accepted principles. Field measurements will be checked for completeness of procedures and documentation of procedures and results.

Precision and accuracy will be determined using replicate samples and blank and spiked samples, respectively. The specific procedures for determining PARCC parameters are outlined in Section 5.0.

12.2 VALIDATION

One hundred percent of the analytical data packages will be validated.

12.3 DATA EVALUATION

The evaluation of the data collected during the field investigation will be a comparison of: chemical concentrations in groundwater versus ARARs (such as the Safe Drinking Water Act MCLs) and risk-based concentrations; and chemical concentrations in soils versus background and risk-based concentrations.

The groundwater and surface water evaluation will be based directly on standards established under Federal and state drinking water standards for volatile organics and metals. For soil and sediment samples organic results, any organics detected will be considered potentially significant. Contaminants detected will only be discounted if very low levels are found (near the detection limit) and they are found infrequently at the site; or if a higher concentration is found but that the concentration in combination with the toxicity of the chemical would not be considered a significant risk to human health or the environment. For soil and sediment sample inorganic results, the result will be compared to soil background sample results. Action levels will be based on a normal frequency distribution of

inorganics in the background soils at the upper 95% of the frequency distribution (one in twenty chance that a background soil sample at that concentration has been "incorrectly" identified as contaminated. The contaminant specific action levels will be calculated as follows.

$$\text{Action Level} = 1.645 * \sigma + x_a$$

where: σ = standard deviation (with $n - 1$ samples)

$$\sigma^2 = 1/(n - 1) * \Sigma(x_i - x_a)^2$$

x_i = individual value

x_a = mean value

n = number of samples

13.0 CORRECTIVE ACTIONS

The QA program will enable problems to be identified, controlled, and corrected. Potential problems may involve nonconformance with the SOPs and/or analytical procedures established for the project or other unforeseen difficulties. Any person identifying an unacceptable condition will notify the project manager. The project manager, with the assistance of the project QA/QC officer, will be responsible for developing and initiating appropriate corrective action and verifying that the correction action has been effective. Corrective actions may include the following: resampling and/or reanalysis of sample, amending or adjusting project procedures. If warranted by the severity of the problem (for example, if a change in the approved work plan is required), the Navy will be notified in writing and their approval will be obtained prior to implementing any change. Additional work that is dependent on a nonconforming activity will not be performed until the problem has been eliminated.

The laboratory maintains an internal closed-loop corrective action system that operates under the direction of the laboratory QA coordinator.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

The QA/QC advisor will review all aspects of the implementation of the work plan on a regular basis and with the use of designated support personnel; will prepare a summary report. Reviews will be performed at the completion of each field activity and reports will be completed at this time. These reports will include an assessment of data quality and the results of system and/or performance audits. Any significant QA deficiencies will be reported and identified, and corrective action possibilities discussed. The laboratory will issue monthly progress reports. Other QA/QC reports are listed in Section 8.0.

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APPENDIX A

STANDARD OPERATING PROCEDURES

- ✓ GH-1.3, Section 5.0; Soil and Rock Sampling
- ✓ GH-1.5, Section 5.0; Borehole and Sample Logging
- ✓ GH-1.6, Section 5.0; Decontamination of Drilling Rigs and Sample Equipment
- GH-1.7, Section 5.0; Groundwater Monitoring Point Installation
- GH-1.8, Section 5.0; Excavation of Exploratory Test Pits and Trenches
- SA-1.1, Section 5.0; Groundwater Sample Acquisition
- SA-1.2, Section 5.0; Surface Water and Sediment Sampling
- ✓ SA-6.1, Section 5.0; Sample Identification and Chain of Custody
- ✓ SA-6.2, Section 5.0; Sample Packaging and Shipping
- ✓ SA-7.1, Section 5.0; Decontamination of Field Equipment and Waste Handling
- SF-1.1, Section 5.0; On-site Water Quality Testing
- SF-1.2, Section 5.0; Sample Preservation
- SF-2.3, Section 5.0; Decontamination of Chemical Sampling and Field Analytical Equipment

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5.0 PROCEDURES

5.1 SUBSURFACE SOIL SAMPLES

Subsurface soil samples are used to characterize subsurface stratigraphy. This characterization can indicate the potential for migration of chemical contaminants in the subsurface. In addition, definition of the actual migration of contaminants can be obtained through chemical analysis of the soil samples. Where the remedial activities may include in-situ treatment or the excavation and removal of the contaminated soil, the depth and areal extent of contamination must be known as accurately as possible.

Engineering and physical properties of soil may also be of interest should site construction activities be planned. Soil types, grain size distribution, shear strength, compressibility, permeability, plasticity, unit weight, and moisture content are some of the physical characteristics that may be determined for soil samples.

Penetration tests are also described in this procedure. The tests can be used to estimate various physical and engineering parameters such as relative density, unconfined compressive strength, and consolidation characteristics of soils.

The procedures described here are representative of a larger number of possible drilling and sampling techniques. The choice of techniques is based on a large number of variables such as cost, DQOs, local geology, etc. The final choice of methods must be made with the assistance of drilling subcontractors familiar with the local geologic conditions. Alternative techniques must be based upon the underlying principles of quality assurance implicit in the following procedures.

5.1.1 Equipment

The following equipment is used for subsurface soil sampling and test boring:

- Drilling equipment, provided by subcontractor.
- Split barrel (split spoon) samplers, OD 2 inches, ID 1-3/8 inches, either 20-inch or 26 inches long. Larger O.D. samplers are available if a larger volume of sample is needed. A common size is 3-inch O.D. (2-1/2-inch I.D.).
- Thin walled tubes (Shelby), O.D. 2 to 5 inches, 18 to 54 inches long.
- Drive weight assembly, 140-lb. (± 2 lb.) weight, driving head and guide permitting free fall of 30 inches (± 1 inch).
- Drive weight assembly, 300-lb. (± 2 lb.) weight, driving head and guide permitting free fall of 18 inches (± 1 inch).
- Accessory equipment, including labels, logbook, paraffin, and sample jars.

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5.1.2 Split Barrel (Split Spoon) Sampling (ASTM D1586-84)

The following method will be used for split barrel sampling:

- Clean out the borehole to the desired sampling depth using equipment that will ensure that the material to be sampled is not disturbed by the operation. In saturated sands and silts, withdraw the drill bit slowly to prevent loosening of the soil around the hole and maintain the water level in the hole at or above groundwater level.
- Side-discharge bits are permissible. A bottom-discharge bit shall not be used. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. Where casing is used, it may not be driven below the sampling elevation.
- Install the split barrel sampler and sampling rods into the boring to the desired sampling depth. After seating the sampler by means of a single hammer blow, three 6-inch increments shall be marked on the sampling rod so that the progress of the sampler can be monitored.
- The 2-inch OD split barrel sampler shall be driven with blows from a 140-lb. (± 2 lb.) hammer falling 30 inches (± 1 inch) until either a total of 50 blows have been applied during any one of the three 6-inch increments, a total of 100 blows have been applied, there is no observed advance of the sampler for 10 successive hammer blows, or until the sampler has advanced 18 inches without reaching any of the blow count limitation constraints described herein. This process is referred to as the Standard Penetration Test.
- A 300-lb. weight falling 18 inches is sometimes used to drive a 2-1/2-inch or 3-inch O.D. spoon sampler. This procedure is used where dense materials are encountered or when a large volume of sample is required. However, this method does not conform the ASTM specifications.
- Repeat this operation at intervals not greater than 5 feet in homogeneous strata, or as specified in the sampling plan.
- Record the number of blows required to effect each 6 inches of penetration or fraction thereof. The first 6 inches is considered to be seating drive. The sum of the number of blows required for the second and third 6 inches of penetration is termed the penetration resistance, N . If the sampler is driven less than 18 inches, the penetration resistance is that for the last 1 foot penetrated.
- Bring the sampler to the surface and remove both ends and one half of the split barrel so that the soil recovered rests in the remaining half of the barrel. Describe carefully the sample interval, recovery (length), composition, structure, consistency, color, condition, etc., of the recovered soil then put a representative portion of each sample into a jar, without ramming. Jars with samples not taken for chemical analysis shall be sealed with wax, or hermetically sealed (using a teflon cap liner) to prevent evaporation of the soil moisture, if the sample is to be later evaluated for moisture content. Affix labels to the jar and complete Chain-of-Custody and other required sample data forms. Protect samples against extreme temperature changes and breakage by placing them in appropriate cartons stored in a protected area. Pertinent data which shall be noted on the label or written on the jar lid for each sample includes the project number, boring number, sample number, depth interval, blow counts, and date of sampling.

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- An addition to the sampler mentioned above is an internal liner, which is split longitudinally and has a thin-wall brass, steel, or paper liner inserted inside, which will preserve the sample. However, since the development of the thin-walled samplers (mentioned below) the split barrel sampler with liner has declined in use.

5.1.3 Thin Walled Tube (Shelby Tube) Sampling (ASTM D1587-83)

When it is desired to take undisturbed samples of soil, thin-walled seamless tube samplers (Shelby tubes) will be used. The following method will be used:

- Clean out the borehole to the sampling depth, being careful to minimize the chance for disturbance of the material to be sampled. In saturated materials, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and maintain the water level in the hole at or above groundwater level.
- The use of bottom discharge bits or jetting through an open-tube sampler to clean out the hole shall not be allowed. Any side discharge bits are permitted.
- A stationary piston-type sampler may be required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used. Prior to inserting the tube sampler in the hole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the sampling rods from pushing the sample out of the tube sampler during sample withdrawal and to maintain a suction within the tube to help retain the sample.
- To minimize chemical reaction between the sample and the sampling tube, brass tubes may be required, especially if the tube is stored for an extended time prior to testing. While steel tubes coated with shellac are less expensive than brass, they are more reactive, and shall only be used when the sample will be tested within a few days after sampling or if chemical reaction is not anticipated. With the sampling tube resting on the bottom of the hole and the water level in the boring at the groundwater level or above, push the tube into the soil by a continuous and rapid motion, without impacting or twisting. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
- Upon removal of the sampler tube from the hole, measure the length of sample in the tube and also the length penetrated. Remove disturbed material in the upper end of the tube and measure the length of sample again. After removing at least an inch of soil from the lower end and after inserting an impervious disk, seal both ends of the tube with at least a 1/2-inch thickness of wax applied in a way that will prevent the wax from entering the sample. Newspaper or other types of filler must be placed in voids at either end of the sampler prior to sealing with wax. Place plastic caps on the ends of the sampler, tape in the caps place, and dip the ends in wax.
- Affix labels to the tubes as required and record sample number, depth, penetration, and recovery length on the label. Mark the same information and "up" direction on the tube with indelible ink, and mark the end of the sample. Complete Chain-of-Custody and other required forms. Do not allow tubes to freeze and store the samples vertically (with the same orientation they had in the ground, i.e., top of sample is up) in a cool place out of the

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sun at all times. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

Thin-walled undisturbed tube samplers are restricted in their usage by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soils with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Denison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soils. Using these devices normally increases sampling costs and therefore their use shall be weighed against the increased cost and the need for an undisturbed sample. In any case, if a sample cannot be obtained with a tube sampler, an attempt shall be made with a split barrel sampler at the same depth so that at least a sample can be obtained for classification purposes.

5.1.4 Continuous Core Soil Samples

The CME continuous sample tube system provides a method of sampling soil continuously during hollow stem augering. The 5-foot sample barrel fits within the lead auger of a hollow auger column. The sampling system can be used with a wide range of I.D. hollow stem augers (from 3-1/4-inch to 8-1/4-inch I.D.). This method has been used to sample many different materials such as glacial drift, hard clays and shales, mine tailings, etc. This method is particularly used when SPT samples are not required and a large volume of material is needed. Also, this method is useful when a visual description of the subsurface lithology is required.

5.2 SURFACE SOIL SAMPLES

For loosely packed earth or waste pile samples, stainless steel scoops or trowels can be used to collect representative samples. For densely packed soils or deeper soil samples, a hand or power soil auger may be used.

The following methods are to be used:

- Use a soil auger for deep samples (6 to 24 inches) or a scoop or trowel for surface samples. Remove debris, rocks, twigs, and vegetation before collection of soil. Mark the location with a numbered stake if possible and locate sample points on a sketch of the site.
- Use a new or freshly-decontaminated sampler for each sample taken. Attach a label and identification tag. Record all required information in the field logbook and on the sample log sheet, Chain-of-Custody record, and other required forms.
- Pack and ship accordingly.
- When a representative composited sample is to be prepared (e.g., samples taken from a gridded area or from several different depths), it is best to composite individual samples in the laboratory where they can be more precisely composited on a weight or volume basis. If this is not possible, the individual samples (all of equal volume, i.e., the sample bottles shall be full) shall be placed in a decontaminated stainless steel bucket, mixed thoroughly using a stainless steel spatula or trowel, and a composite sample collected.

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5.3 WASTE PILE SAMPLES

The use of stainless steel scoops or trowels to obtain small discrete samples of homogeneous waste piles is usually sufficient for most conditions. Layered (nonhomogeneous) piles require the use of tube samplers to obtain cross-sectional samples.

- Collect small, equal portions of the waste from several points around the pile, penetrating it as far as practical. Use numbered stakes, if possible, to mark the sampling locations and locate sampling points on the site sketch.
- Place the waste sample in a glass container. Attach a label and identification tag. Record all the required information in the field logbook and on the sample log sheet and other required forms.

For layered, nonhomogeneous piles, grain samplers, sampling triers, or waste pile samplers must be used at several representative locations to acquire a cross-section of the pile. The basic steps to obtain each sample are

- Insert a sampler into the pile at a 0- to 45-degree angle from the horizontal to minimize spillage.
- Rotate the sampler once or twice to cut a core of waste material. Rotate the grain sampler inner tube to the open position and then shake the sampler a few times to allow the material to enter the open slits. Move the sampler into position with slots upward (grain sampler closed) and slowly withdraw from the pile.

5.4 ROCK SAMPLING (CORING) (ASTM D2113-83)

Rock coring enables a detailed assessment of borehole conditions to be made, showing precisely all lithologic changes and characteristics. Because coring is an expensive drilling method, it is commonly used for shallow studies of 500 feet or less, or for specific intervals in the drill hole that require detailed logging and/or analyzing. It can, however, proceed for thousands of feet continuously, depending on the size of the drill rig. It yields better quality data than air rotary drilling, although at a substantially reduced drilling rate. Rate of drilling varies widely, depending on the characteristics of lithologies encountered, drilling methods, depth of drilling, and condition of drilling equipment. Average output in a 10-hour day ranges from 40 to over 200 feet. Downhole geophysical logging or television camera monitoring is sometimes used to complement the data generated by coring.

Borehole diameter can be drilled to various sizes, depending on the information needed. Standard sizes of core barrels (showing core diameter) and casing are shown in Attachment No. 1.

Core drilling is used when formations are too hard to be sampled by soil sampling methods and a continuous solid sample is desired. Usually, soil samples are used for overburden, and coring begins in sound bedrock. Casing is set into bedrock before coring begins to prevent loose material from entering the borehole, to prevent loss of drilling fluid, and to prevent cross contamination of aquifers.

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ATTACHMENT 1

STANDARD SIZES OF CORE BARRELS AND CASING

Coring bit size	Nominal *		Set size *	
	O.D.	I.D.	O.D.	I.D.
RWT	$1 \frac{5}{32}$	$\frac{3}{4}$	1.160	.735
EWT	$1 \frac{1}{2}$	$\frac{29}{32}$	1.470	.905
EX, EXL, EWG, EWM	$1 \frac{1}{2}$	$\frac{13}{16}$	1.470	.845
AWT	$1 \frac{7}{8}$	$1 \frac{9}{32}$	1.875	1.281
AX, AXL, AWG, AWM	$1 \frac{7}{8}$	$1 \frac{3}{16}$	1.875	1.185
BWT	$2 \frac{3}{8}$	$1 \frac{3}{4}$	2.345	1.750
BX, BXL, BWG, BWM	$2 \frac{3}{8}$	$1 \frac{3}{8}$	2.345	1.655
NWT	3	$2 \frac{9}{16}$	2.965	2.313
NX, NXL, NWG, NWM	3	$2 \frac{1}{8}$	2.965	2.155
HWT	$3 \frac{29}{32}$	$3 \frac{3}{16}$	3.889	3.187
HWG	$3 \frac{29}{32}$	3	3.889	3.000
$2 \frac{3}{4} \times 3 \frac{7}{8}$	$3 \frac{7}{8}$	$2 \frac{3}{4}$	3.840	2.690
$4 \times 5 \frac{1}{2}$	$5 \frac{1}{2}$	4	5.435	3.970
$6 \times 7 \frac{3}{4}$	$7 \frac{3}{4}$	6	7.655	5.970
AX Wire line <u>1/</u>	$1 \frac{7}{8}$	1	1.875	1.000
BX Wire line <u>1/</u>	$2 \frac{3}{8}$	$1 \frac{7}{16}$	2.345	1.437
NX Wire line <u>1/</u>	3	$1 \frac{15}{16}$	2.965	1.937

* All dimensions are in inches; to convert to millimeters, multiply by 25.4.

1/ Wire line dimensions and designations may vary according to manufacturer

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ATTACHMENT 1
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Size Designations		Casing O.D., inches	Casing coupling		Casing bit, O.D., inches	Core barrel bit O.D., inches*	Drill rod O.D., inches	Approximate core diameter	
Casing; Casing coupling; Casing bits; Core barrel bits	Rod; Rod couplings		O.D., inches	I.D., inches				Normal, inches	Thinwall, inches
RX	RW	1.437	1.437	1.188	1.485	1.160	1.094	—	.735
EX	E	1.812	1.812	1.500	1.875	1.470	1.313	.845	.905
AX	A	2.250	2.250	1.906	2.345	1.875	1.625	1.185	1.281
BX	B	2.875	2.875	2.375	2.965	2.345	1.906	1.655	1.750
NX	N	3.500	3.500	3.000	3.615	2.965	2.375	2.155	2.313
HX	HW	4.500	4.500	3.938	4.625	3.890	3.500	3.000	3.187
RW	RW	1.437	Flush joint	No coupling	1.485	1.160	1.094	—	.735
EW	EW	1.812			1.875	1.470	1.375	.845	.905
AW	AW	2.250			2.345	1.875	1.750	1.185	1.281
BW	BW	2.875			2.965	2.345	2.125	1.655	1.750
NW	NW	3.500			3.615	2.965	2.625	2.155	2.313
HW	HW	4.500			4.625	3.890	3.500	3.000	3.187
PW	—	5.500			5.650	—	—	—	—
SW	—	6.625			6.790	—	—	—	—
UW	—	7.625	—	—	7.800	—	—	—	—
ZW	—	8.625			8.810	—	—	—	—
—	AX <u>✓</u>	—			—	1.875	1.750	1.000	—
—	BX <u>✓</u>	—			—	2.345	2.250	1.437	—
—	NX <u>✓</u>	—			—	2.965	2.813	1.937	—

* For hole diameter approximation, assume $\frac{1}{32}$ inch larger than core barrel bit.

✓ Wire line size designation, drill rod only, serves as both casing and drill rod. Wire line core bit, and core diameters vary slightly according to manufacturer.

NOMINAL DIMENSIONS FOR DRILL CASINGS AND ACCESSORIES. (DIAMOND CORE DRILL MANUFACTURERS ASSOCIATION). 288-D-2889.

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Drilling through bedrock is initiated by using a diamond-tipped core bit threaded to a drill rod (outer core barrel) with a rate of drilling determined by the downward pressure, rotation speed of drill rods, drilling fluid pressure in the borehole, and the characteristics of the rock (mineralogy, cementation, weathering).

5.4.1 Diamond Core Drilling

A penetration of typically less than 6 inches per 50 blows using a 140-lb. hammer dropping 30 inches with a 2-inch split spoon sampler shall be considered an indication that soil sampling methods may not be applicable and that coring may be necessary to obtain samples.

When formations are encountered that are too hard to be sampled by soil sampling methods, the following diamond core drilling procedure may be used.

- Firmly seat a casing into the bedrock or the hard material to prevent loose materials from entering the hole and to prevent the loss of drilling fluid return. Level the surface of the rock or hard material when necessary by the use of a fishtail or other bits. If the drill hole can be retained open without the casing and if cross contamination of aquifers in the unconsolidated materials is unlikely, it may be omitted.
- Begin the core drilling using a double-tube swivel-core barrel of the desired size. After drilling no more than 10 feet (3 m), remove the core barrel from the hole, and take out the core. If the core blocks the flow of the drilling fluid during drilling, remove the core barrel immediately. In soft materials, a large starting size may be specified for the coring tools; where local experience indicates satisfactory core recovery or where hard, sound materials are anticipated, a smaller size or the single-tube type may be specified and longer runs may be drilled. NX/NW size coring equipment is the most commonly used size.
- When soft materials are encountered that produce less than 50 percent recovery, stop the core drilling. If soil samples are desired, secure such samples in accordance with the procedures described in ASTM Method D 1586 (Split Barrel Sampling) or in Method D 1587 (Thin-Walled Tube Sampling) for Sampling of Soils (see Section 5.1.1 and 5.1.2). Resume diamond core drilling when refusal materials are again encountered.
- Since rock structures and the occurrence of seams, fissures, cavities, and broken areas are among the most important items to be detected and described, take special care to obtain and record these features. If such broken zones or cavities prevent further advance of the boring, one of the following three steps shall be taken: (1) cement the hole; (2) ream and case; or (3) case and advance with the next smaller size core barrel, as the conditions warrant.
- In soft, seamy, or otherwise unsound rock, where core recovery may be difficult, M-design core barrels may be used. In hard, sound rock where a high percentage of core recovery is anticipated, the single-tube core barrel may be employed.

5.4.2 Rock Sample Preparation and Documentation

Once the rock coring has been completed and the core recovered, the rock core shall be carefully removed from the barrel, placed in a core tray (previously labeled "top" and "bottom" to avoid confusion), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). Each core shall be described, classified, and logged using a uniform system as presented in Procedure GH-1.5. If moisture content will be determined or if it is desirable to prevent drying (e.g.,

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to prevent shrinkage of clay formations) or oxidation of the core, the core shall be wrapped in plastic sleeves immediately after logging. Each plastic sleeve shall be labeled with indelible ink. The boring number, run number, and the footage represented in each sleeve shall be included, as well as the top and bottom of the core run.

After sampling, rock cores shall be placed in the sequence of recovery in well-constructed wooden boxes provided by the drilling contractor. Rock cores from two different borings shall not be placed in the same core box unless accepted by the Site Geologist. The core boxes shall be constructed to accommodate at least 20 linear feet of core in rows of approximately 5 feet each and shall be constructed with hinged tops secured with screws, and a latch (usually a hook and eye) to keep the top securely fastened down. Wood partitions shall be placed at the end of each core run and between rows. The depth from the surface of the boring to the top and bottom of the drill run and run number shall be marked on the wooden partitions with indelible ink. A wooden partition (wooden block) shall be placed at the end of each run with the depth of the bottom of the run written on the block. These blocks will serve to separate successive core runs and indicate depth intervals for each run. The order of placing cores shall be the same in all core boxes. Rock core shall be placed in the box so that, when the box is open, with the inside of the lid facing the observer, the top of the cored interval contained within the box is in the upper left corner of the box, and the bottom of the cored interval is in the lower right corner of the box (see Attachment 2). The top and bottom of each core obtained and its true depth shall be clearly and permanently marked on each box. The width of each row must be compatible with the core diameter to prevent lateral movement of the core in the box. Similarly, an empty space in a row shall be filled with an appropriate filler material or spacers to prevent longitudinal movement of the core in the box.

The inside and outside of the core-box lid shall be marked by indelible ink to show all pertinent data on the box's contents. At a minimum, the following information shall be included:

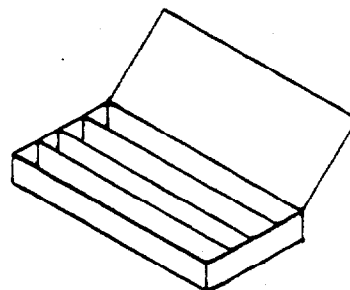
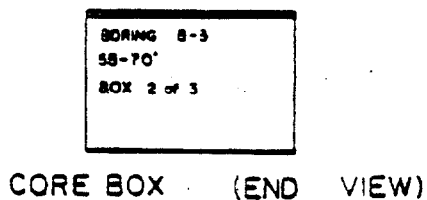
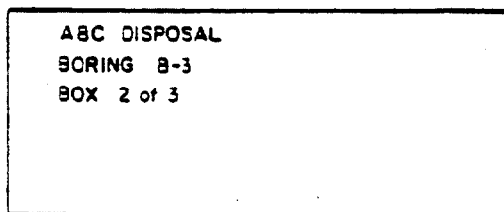
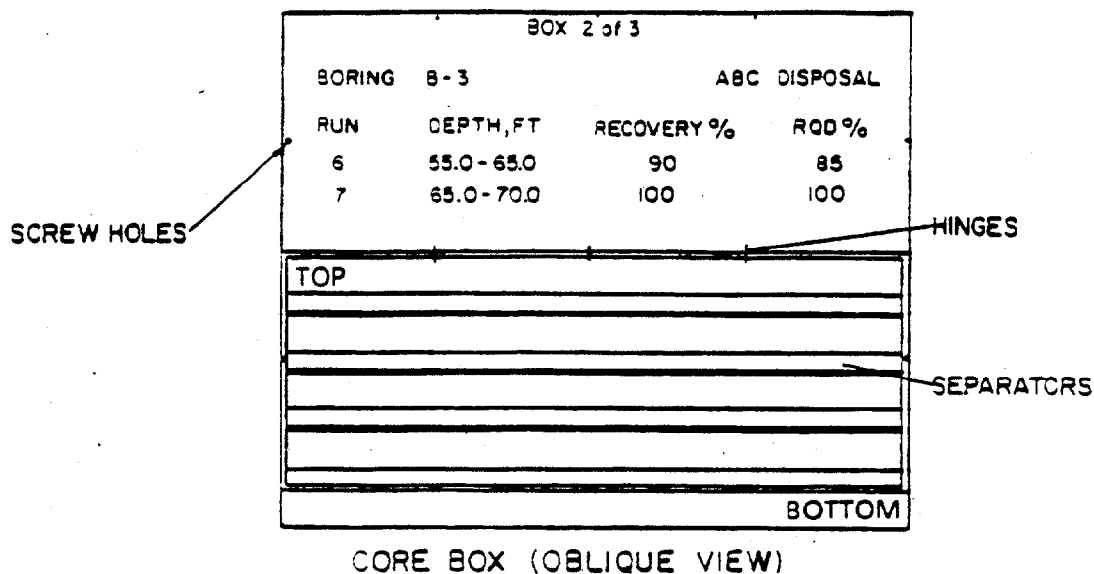
- Project name
- Project number
- Boring number
- Run numbers
- Footage (depths)
- Recovery
- RQD (%)
- Box number and total number of boxes for that boring (Example: Box 5 of 7).

For easy retrieval when core boxes are stacked, the sides and ends of the box shall also be labeled and include project number, boring number, top and bottom depths of core and box number. Attachment No. 2 illustrates a typical rock core box.

Prior to final closing of the core box, a photograph of the recovered core and the labeling on the inside cover shall be taken. If moisture content is not critical, the core shall be wetted and wiped clean for the photograph. (This will help to show true colors and bedding features in the cores).

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ATTACHMENT 2



TYPICAL ROCK CORE BOX

NOT TO SCALE

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1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist - Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used onsite the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 MATERIALS NEEDED

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute HCl
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 CLASSIFICATION OF SOILS

All data shall be written directly on the boring log (Exhibit 4-1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

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5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Exhibit 4-2. This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as (1/4 inch ϕ -1/2 inch ϕ) or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.2. Those designations are:

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Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140 pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, and SC (see Exhibit 4-2).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Exhibit 4-3. Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Exhibit 4-2).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength) or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are as follows:

Consistency	Unc. Compressive Str. Tons/Square Foot	Standard Penetration Resistance (Blows per Foot)	Field Identification Methods
Very soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb
Medium stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb
Very stiff	1.0 to 2.0	8 to 15	Readily indented by thumb
Hard	2.0 to 4.0	15 to 30	Readily indented by thumbnail
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail

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5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
trace	0 - 10 percent
some	11 - 30 percent
and or adjective form of the soil type (e.g., "sandy")	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Exhibit 4-4.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

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5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

5.3 CLASSIFICATION OF ROCKS

Rocks are grouped into three main divisions, including sedimentary, igneous and metamorphic rocks. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Vary fine grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite (CaCO_3). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. These include conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

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5.3.1 Rock Type

As described above, there are numerous names of sedimentary rocks. In most cases a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Exhibit 4-5 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a handlens, the rock is a siltstone. If the grains are not distinguishable with a handlens, the rock is a claystone.

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock Color Charts shall not be used unless specified by the project manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).
- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.
- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.
- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the words "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

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5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2 in. spacing between fractures
- Broken (BR.) - 2 in. to 1 ft. spacing between fractures
- Blocky (BL.) - 1 to 3 ft. spacing between fractures
- Massive (M.) - 3 to 10 ft. spacing between fractures

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD (After Deere, 1964)

$$RQD \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified)
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic)

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- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inch or less), probably continuous layer.
- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse grained dark igneous rock.

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The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

5.4 ABBREVIATIONS

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow
Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine grained
Tr - Trace		

5.5 BORING LOGS AND DOCUMENTATION

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Exhibit 4-6. The field geologist/engineer shall use this example as a guide in completing each borings log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided on the back of the boring log, for field use.

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.
- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology a 13.7 feet, shall be lined off at the proportional location between the 13 and 14 foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.

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- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.
- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.
- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart of back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.
- Enter color of the material in the appropriate column.
- Describe material using the USCS. Limit this column for sample description only. The predominate material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:
 - Trace 0 - 10 percent
 - Some 11 - 30 percent
 - And 31 - 50 percent
- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.
- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.
- The following information shall be entered under the Remarks Column and shall include, but is not limited by the following:
 - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.
 - Angularity - describe angularity of coarse grained particles using Angular, Subangular, Subrounded, Rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.
 - Particle shape - flat, elongated, or flat and elongated.
 - Maximum particle size or dimension.
 - Water level observations.
 - Reaction with HCl - none, weak or strong.

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- Additional comments:

- Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.
- Indicate odor and HNu or OVA reading if applicable.
- Indicate any change in lithology by drawing in line through the lithology change column and indicate the depth. This will help later on when cross-sections are constructed.
- At the bottom of the page indicate type of rig, drilling method, hammer size and drop and any other useful information (i.e., borehole size, casing set, changes in drilling method).
- Vertical lines shall be drawn (as shown in Exhibit 4.6) in columns 5 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.
- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent and core recovery under the appropriate columns.
- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.
- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.
- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.
- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.
- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.

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- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:
 - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.
 - Indicate calcareous zones, description of any cavities or vugs.
 - Indicate any loss or gain of drill water.
 - Indicate drop of drill tools or change in color of drill water.
- Remarks at the bottom of Boring Log shall include:
 - Type and size of core obtained.
 - Depth casing was set.
 - Type of Rig used.
- As a final check the boring log shall include the following:
 - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.
 - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5 foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date etc.). Cuttings shall be closely examined to determine general lithology.
- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Exhibit 4-1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split barrel and rock core sampling methods be used at selected boring locations during the field investigation to

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provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 REVIEW

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs
- Checking for conformance to the guideline
- Checking to see that all information is entered in their respective columns and spaces

6.0 REFERENCES

Unified Soil Classification System (USCS)

ASTM D2488, 1985

Earth Manual, U.S. Department of the Interior, 1974

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

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EXHIBIT 4-2

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)									
COARSE GRAINED SOILS More than half of material is LARGER than No. 200 sieve size					FINE GRAINED SOILS More than half of material is SMALLER than No. 200 sieve size				
FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3" & basing fractions on estimated weights)			GROUP SYM-BOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3" & basing fractions on estimated weights)			GROUP SYM-BOL	TYPICAL NAMES
GRAVELS 60-100% No. 20 & larger	CLEAN GRAVELS Less than 5% fines	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel sand mixtures, little or no fines	Identification procedures on fraction smaller than No. 40 sieve size				
		Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel sand mixtures, little or no fines	SILTS & CLAYS 20-60% finer than No. 40	DRY STRENGTH (Crushing Characteristics)	DEPLASTANCY (Reaction to Shaking)	TOUGHNESS (Consistency from Plastic Limit)	
		Non plastic fines (for identification procedures see ML)	GM	Silty gravels, poorly graded gravel sand mixtures		None to slight	Quick to slow	None	ML
		Plastic fines (for identification procedures see CL)	GC	Clayey gravels, poorly graded gravel sand mixtures		Medium to high	None to very slow	Medium	CL
SANDS 40-60% No. 20 & larger	CLEAN SANDS Less than 5% fines	Wide range in grain size and substantial amounts of all intermediate particle sizes	SW	Well graded sand, gravelly sands, little or no fines		Slight to medium	Slow	Slight	OL
		Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines	SILTS & CLAYS 60-100% finer than No. 40	Slight to medium	Slow to none	Slight to medium	MH
		Non plastic fines (for identification procedures see ML)	SM	Silty sands, poorly graded sand mixtures		High to very high	None	High	CH
		Plastic fines (for identification procedures see CL)	SC	Clayey sands, poorly graded sand mixtures		Medium to high	None to very slow	Slight to medium	OH
					HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example GSW GC, well graded gravel sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT
Very loose	0-4
Loose	5-10
Medium dense	11-30
Dense	31-50
Very dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC. COMPRESSIVE STR. TONS/SQ. FT.	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb
Medium stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb
Very stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)		
DESCRIPTIVE TERMS	SCREWDRIVER OR KNIFE EFFECTS	HAMMER EFFECTS
Soft	Easily gouged	Crushes when pressed with hammer
Medium soft	Can be gouged	Breaks (one blow) Crumbly edges
Medium hard	Can be scratched	Breaks (one blow) Sharp edges
Hard	Cannot be scratched	Breaks conchordally (several blows) Sharp edges

ROCK BROKENNESS		
DESCRIPTIVE TERMS	ABBREVIATION	SPACING
Very broken	(V. Br.)	0-2"
Broken	(Br.)	2"-1'
Blocky	(Bl.)	1'-3'
Massive	(M.)	3'-10'

LEGEND

SOIL SAMPLES - TYPES

1. 2" O.D. Split Barrel Sample
 ST - 1" O.D. Undisturbed Sample
 O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

- R - R (Conventional) Core (-2 1/8" O.D.)
 Q - RQ (Washers) Core (-1 7/8" O.D.)
 Z - Other Core Sizes, Specify in Remarks

WATER LEVELS

- 12:18
 T-12A Initial Level - Date & Depth
 12:18
 T-12A Standstill Level - Date & Depth

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EXHIBIT 4-3

CONSISTENCY FOR COHESIVE SOILS

Consistency	(Blows per Foot)	Unconfined Compressive Strength (tons/square foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented by thumbnail

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EXHIBIT 4-4

BEDDING THICKNESS CLASSIFICATION

Thickness (Metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	< 1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

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EXHIBIT 4-5

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4-64 mm
Granules	2-4 mm
Very Coarse Sand	1-2 mm
Coarse Sand	0.5-1 mm
Medium Sand	0.25-0.5 mm
Fine Sand	0.125-0.25 mm
Very Fine Sand	0.0625-0.125 mm
Silt	0.0039-0.0625 mm

After Wentworth, 1922

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BORING LOG										NUS CORPORATION	
PROJECT: HEBELKA SITE										BORING NO.: MW 3A	
PROJECT NO.: 619Y										DATE: 9-22-87	
ELEVATION:										DRILLER: B. GOLLHUE	
WATER LEVEL DATA:										FIELD GEOLOGIST: SJ CONTI	
(Date Time & Conditions)											
SAMPLE NO & TYPE	DEPTH (FT.)	BLOWS 6" OR 400 (1")	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (Depth ft.)	MATERIAL DESCRIPTION*			JCS	REMARKS		
					FOR DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION				
9-22	25.0				M.HARD	GRAY	SILTY SHALE (SILTSTONE)	VBR	SHALE IS VBR W/ HORIZ TO 10 & JNTS		
							- FEW QUARTZ SEAMS		~26 TO 27 2" VERT JOINTS. IRON STAINS ON JNTS ROCK BECOMES AND BREAKS MORE LIKE A SILTSTONE WITH DEPTH.		
0/0.0	2	0%	8 7/10.0								
	35.0				M.HARD	GRAY	SILTY SHALE (SILTSTONE)	VBR	~32 TO 33 FEW QUARTZ PIECES W/ VUGS. SL. MICALIZED VF QUARTZ GRAINS IN MATRIX - BOX MAG. ~34 TO 35 2" VERT JOINTS		
							- FEW QUARTZ SEAMS	BR	35.0-35.5 QUARTZ PIECES		
1-9/10.0	3	100%	9 3/10.0						BECOMES SL. CALCAR. 2 3/4" THIN CALCITE LAMINATIONS WATER STAINED JNTS THRUOUT RUN MORE SO 35-37 ± 39.5 → 42.0		
	45.0								42.7 → 43.0 HI & JNT 42.4 → 42.7 VERT JNT		
									43.3 → 45.5 VERT JNT. & VBR		
									47.5 VERT JOINT		
									48. HI & JNT SLIGHTLY CALCAREOUS MORE CALCITE PRESENT		

REMARKS _____

BORING MW 3A

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* See Legend on Back

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BORING LOG						NUS CORPORATION			
PROJECT: HEBELKA SITE				BORING NO: MW 3A					
PROJECT NO: 619Y				DATE: 9-22-87		DRILLER: B. GOLLHUE			
ELEVATION:				FIELD GEOLOGIST: SJ. CONTI					
WATER LEVEL DATA (Date, Time & Conditions)									
SAMPLE NO & TYPE	DEPTH (ft.)	BLOWS 6" DR ROD (ft.)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (depth in ft.)	MATERIAL DESCRIPTION*		USCS	REMARKS	
					SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR			
1-9/100 ④	19.0/10.0	10.0/10.0			M. HARD	GRAY	SILTY SHALE (SILTSTONE)	VER	50.5 → 51.0 VER
							SL. CALcareous	BR	51.5 → 54.0 BR w/ SEV LO & JOINTS
	55.0								
									VER POOR RECOVERY w/ SOFT ZONES.
0/10 ⑤	00/10.0	1.8/10.0							
	65.0								
0/0 ⑥	00/10.0	1.3/10.0							68.0 - DRILLER NOTED SOFT AREA - LOSS OF 1/3 OF WATER - CHANGE IN COLOR OF DRILL WATER TO YELLOW BROWN
									POOR RECOVERY FEW CALcareous ZONES.
	75.0								

REMARKS AT 75' @ 1:45 PM - PULLING TOOLS - TO REAM HOLE.
AT 1:50 PM CORED HOLE TO 75' REAMED TWICE
DUE TO RUNNING SAND (FRACTURE) AT 68. REAMED
 * See Legend on Back 2ND TIME TO 81'. SET WELL 66'-70'.

BORING MW 3A
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EXHIBIT 4-6

BORING LOG						NUS CORPORATION		
PROJECT: WESTLINE SITE			BORING NO.: M'W 013					
PROJECT NO.: 473 Y			DATE: 7-7-87		DRILLER: B. FRIZZON			
ELEVATION: 1462.37			FIELD GEOLOGIST: S.J. CONTI		PENNY-DRILL			
WATER LEVEL DATA: 5.54' @ 8:50 AM 7-23-87 T-PVC					ACKER AD-11			
(Date, Time & Conditions)								
SAMPLE NO. & TYPE OR ROD	DEPTH (IN) OR RUN NO.	SLOWS 1" OR ROD (IN)	SAMPLE RECOVERY SAMPLE LENGTH	LITHOLOGY CHANGE (DEBRIS) OR SLACKEN ENT	MATERIAL DESCRIPTION		REMARKS (HAND) (HEAD SP)	
					SOIL DENSITY CONSISTENCY OR ROCK HARDNESS	COLOR		
	0.0	3	1.4/1.5		LOOSE	BLK BRN	CLAYEY SILT AND CINCEP	ML MOIST (OPPM)
S-1		2					TR-20L FEL. S.	3/4" Ø FERG - NEAR OLD RR. LINE.
							TR-20 FRAG	
							(FILL)	
	3.0							
S-2		1	1.3/1.5	6.0	V. LOOSE	RED EARTH TO GRAY	SANDY SILT-TR FGS TO	GM MOIST TO WET (OPPM)
	4.5	3					SILTY SAND-TR GRAVEL	GRAY SAND 2' G ±
								INDICATES
								LOOK + METHOD
	10.0							DRILLER NOTE H2O 8-10'
S-3		11	1.2/1.5		DENSE	BRN	SILTY SAND AND S.S.	GM WET (OPPM)
	11.5	27					FRAGS (GRN)	1" Ø SIZE MAX SIZE
								SUBANGULAR TO SUBROUND GRAVEL
	15.0							
S-4		7	1.0/1.5		V. DENSE	BRN	SILTY FINE TO C. SAND	GM WET (OPPM)
	16.5	43					AND GRAVEL	1" Ø SIZE MAX SIZE
								SUBANGULAR TO SUBROUND GRAVEL
	20.0							
S-5	20.9	17	1.4/1.9		V. DENSE	DRNG BRN	SILTY SAND - SOME	GM WET (OPPM)
							GRAVEL AND	MOIST
							S.S. FRGS	BECOMES MORE LIKE
								SANDY SILT AT BOTM
								OF SAMPLE

REMARKS: START @ 1:15 PM - 7-7-87 USING 4 1/4" ID HOLLOW CHISEL
S-4 @ 3:30 PM - TO LOCATE THE BORING USING
S-5 @ 4:30 PM - ACKER DRILL - MONITORING ON
FOUL 8000 TRUCK
SAMPLES TAKEN
USING 140 LB WT AND 30 INCH DROP.

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BORING LOG

NUS CORPORATION

PROJECT: WESTLINE SITE

BORING NO.: 14AD013

PROJECT NO.: 473Y

DATE: 7-7-87

DRILLER: E EPSON

ELEVATION:

FIELD GEOLOGIST: SJ CONTI

WATER LEVEL DATA

(Date, Time & Conditions)

[illegible]

REMARKS

S-6 @ 4:40 PM

5-2 • 8:34 AM 7-E-8

S-10 @ 10:45 L.A. S-11 @

BORING MW013

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BORING LOG

NUS CORPORATION

PROJECT: WESTLINE SITE

BORING NO.: MW 013

PROJECT NO.: 473 Y

DATE: 7-8-87.

DRILLER: E. E. GOSWAMI

ELEVATION:

FIELD GEOLOGIST: S. C. COLE

WATER LEVEL DATA:

(Date, Time & Conditions)

[illegible]

REMARKS WING- HOLLOW SHEET TO ADJUSTE BORG- WAGGING- OUT

TURN AGERS, UNIFORM DEFILED IN YELLOW SHIRT

S-12 C 1:46 PM

S-13 → 3:32 PM - LOGJEL IN BY 3:47 PM

SET 6" ϕ STEEL CASING TO 62'- WILL DRILL SEPT. CASING
AFTER GROUT SETS UP. 5:14 @ 3:20 PM 7.13.27

5-14 @ 3:30 PM 7-13-27
5-15 @ 7:57 AM 7-14-27

BOILING MW 013

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Subject DECONTAMINATION OF DRILLING RIGS AND MONITORING WELL MATERIALS	Number GH-1.6	Page 2 of 3
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1.0 PURPOSE

The purpose of this procedure is to provide reference information regarding the appropriate procedures to be followed when conducting decontamination activities of drilling equipment and monitoring well materials used during field investigations.

2.0 SCOPE

This procedure addresses only drilling equipment and monitoring well materials decontamination, and shall not be considered for use with chemical sampling and field analytical equipment decontamination.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Field Operations Leader - Responsible for ensuring that project specific plans and the implementation of field investigations are in compliance with these procedures.

5.0 PROCEDURES

To insure that analytical chemical results are reflective of the actual concentrations present at sampling locations, various drilling equipment involved in field investigations must be properly decontaminated. This will minimize the potential for cross-contamination between sampling locations, and the transfer of contamination off site.

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental sample. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.) In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens.

The steam cleaning area shall be designed to contain decontamination wastes and waste waters, and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow above-surface tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases, due to budget constraints, such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. The location of the steam cleaning area shall be on site in order to minimize potential impacts at certain sites.

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Guidance to be used when decontaminating equipment shall include:

- As a general rule, any part of the drilling rig which extends over the borehole, shall be steam cleaned.
- All drilling rods, augers, and any other equipment which will be introduced to the hole shall be steam cleaned.
- The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Rinsate samples of well casing and screens may be necessary if specifically required for a given site. If required, at least 1 percent, and no more than 5 percent of steam cleaned lengths of casing and screens combined shall be sampled.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

6.0 RECORDS

None.

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5.0 PROCEDURES

5.1 EQUIPMENT/ITEMS NEEDED

Below is a list of items that may be needed while installing a monitoring well.

- Health and safety equipment as required by the site safety officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineers tape, water level indicator, retractable engineers rule electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installations tools (Sledge Hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 WELL DESIGN

The objectives for each monitoring well and its intended use must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials to be used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity)

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, these can be determined through the review of geologic data and the site terrain. In addition, production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the levels at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contamination plume, since groundwater samples collected in wells that are screened over the full thickness of the water bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of

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contamination in water bearing zone. The well diameter would depend upon the hydraulic characteristics of the water bearing zone. Sampling requirements, drilling method and cost.

The decision concerning the monitored interval and well depth is based on the following information:

- The vertical location of the contaminant source in relation to the water bearing zone.
- The depth, thickness and uniformity of the water bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (1 to 2 feet) are usually required where flow lines are not horizontal, (ie., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs

Standard monitoring well diameters are 2, 4, 6, or 8 inches. However, drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open hole monitoring wells are required. In the smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced, however, the type of sampling devices that can be used are limited. In specifying well diameter, sampling requirements must be considered. Up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples. The water in the monitoring well available for sampling is dependent on the well diameter as follows:

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Casing Inside Diameter, Inch	Standing Water Depth to Obtain 1 Gal Water (feet)	Total Depth of Standing Water for 4 Gal. (feet)
2	6.13	25
4	1.53	6
6	0.68	3

However, if a specific well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

Pumping tests for determining aquifer characteristics may require larger diameter wells; however, in small diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength" and Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well-screen and riser materials depends on the method of drilling, the type of subsurface materials in which the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC, galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive discussion on this topic). The two most commonly used materials are PVC and stainless steel for wells in which screens are installed and are compared in Attachment B. Stainless steel is preferred where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, and ease of manipulation; however, there are also some questions about organic chemical sorption and leaching that are currently being researched (see Barcelona et al., 1983). Concern about the use of PVC can be minimized if PVC wells are used strictly for geohydrologic measurements and not for chemical sampling. The crushing strength of PVC may limit the depth of installation, but schedule 80 materials normally used for wells greater than 50 feet deep may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps to be used for sampling or testing. Due to this problem, the minimum well pipe size recommended for schedule 80 wells is 4 inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe, may corrode and release metal ions or chemically react with organic constituents, but this is considered by some to be less of a problem than the problem associated with PVC material. Galvanized steel is not recommended for metal analyses, as zinc and cadmium levels in groundwater samples may be elevated from the zinc coating.

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Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints at slightly more costs. Welded-joint steel casing is also acceptable. Glued PVC may release organic contamination into the well and therefore should not be used if the well is to be sampled for organic contaminants.

When the water bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary and the screened interval is artificially packed with a fine sand. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The rig geologist shall specify the combination of screen slot size and sand pack which will be compatible with the water bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. (For example, as a standard procedure, a Morie No. 1 or Ottawa sand may be used with a 0.010-inch slot screen, however, with a 0.020-inch slot screen, the filter pack material must be the material retained on a No. 20 to No. 30 U.S. standard sieve.)

5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a fine to medium grained well graded, silica sand. The quantity of sand placed in the annular space is dependent upon the length of the screened interval but should always extend at least 1 foot above the top of the screen. At least one to three feet of bentonite pellets or equivalent shall be placed above the sand pack. The cement-bentonite grout or equivalent extends from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally, i.e., no artificial sand pack will be installed, and the natural formation material will be allowed to collapse around the well screen after the well is installed. This method has been utilized where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets to the surface. The grout effectively seals the well and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom of the hole upward, to prevent bridging and to provide a better seal. However, in boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of two assemblages of material, i.e., a cement-bentonite grout. A cement bentonite grout normally is a mixture of cement, bentonite and water at a ratio of one 90-pound bag of Portland Type I cement, 3-5 pounds of granular or flake-type bentonite and 6 gallons of water. A neat cement is made up of one ninety-pound bag of Portland Type I cement and 6 gallons of water.

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In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets or equivalent. A short (1'-2') section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is often placed over the top for the well. This casing generally has a hinged cap and can be locked to prevent vandalism. A vent hole shall be provided in the cap to allow venting of gases and maintain atmospheric pressure as water levels rise or fall in the well. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

A Protective casing which is level with the ground surface is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter protective sleeve is set into the wet cement around the well with the top set level with the pavement. A manhole type lid placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 MONITORING WELL INSTALLATION

5.3.1 Monitoring Wells in Unconsolidated Sediments

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineers rule to ensure proper well placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, then the sand pack can be installed. A weighted tape measure must be used during the procedure in order to carefully monitor installation progress. The sand is poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur.

After the sand pack is installed to the desired depth, (at least 1 foot above the top of the screen) then the bentonite pellet seal or equivalent, can be installed, in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack.

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The cement-bentonite grout is then mixed and either poured or tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

In stable formations where borehole collapse does not occur, the well can be installed as discussed above, and the use of a temporary casing is not needed. However, centralizers may have to be installed, one above, and one below the screen, to assure enough annular space for sand pack placement. A typical overburden monitoring well sheet is shown.

5.3.2 Confining Layer Monitoring Wells

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large diameter boring through the upper aquifer, 1 to 3 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting the outer casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for installation of the monitoring well as detailed for overburden monitoring wells; with the exception of not using a temporary casing during installation. Sufficient time which will be determined by the rig geologist; must be allowed for setting of the grout prior to drilling through the confined layer. A typical confining layer monitoring well sheet is shown in Attachment C.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 feet into the bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout is cured, a smaller diameter boring is continued through the bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. However, if a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be installed temporary until final well installation is completed. Typical well construction forms for bedrock monitoring wells are shown in Attachment C.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be driven to depths exceeding 10 feet.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only one or two small-diameter tubes extending to the surface. Manufacturers of these types of samplers claim that four samplers can be installed in a 3-inch diameter borehole. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross contamination from sampling equipment. These samplers also perform well when the water table is within 25 feet from the surface (the typical range of suction pumps). Two manufacturers of these samplers are Timco Manufacturing Company, Inc., of

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Prairie du Sac, Wisconsin, and BARCAD Systems, Inc., of Concord, Massachusetts. Each offers various construction materials.

Two additional types of multilevel sampling systems have been developed. Both employ individual screened openings through a small-diameter casing. One of these systems (marketed by Westbay Instruments Ltd. of Vancouver, British Columbia, Canada) uses a screened port and a sampling probe to obtain samples and head measurements or perform permeability tests. This system allows sampling ports at intervals as close as 5 feet, if desired, in boreholes from 3 to 4.8 inches in diameter.

The other system, developed at the University of Waterloo at Waterloo, Ontario, Canada, requires field assembly of the individual sampling ports and tubes that actuate a simple piston pump and force the samples to the surface. Where the depth to ground water is less than 25 feet, the piston pumps are not required. The assembly is made of easily obtained materials; however, the cost of labor to assemble these monitoring systems may not be cost-effective.

5.4 WELL DEVELOPMENT METHODS

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity and temperature taken during development may yield information (stabilized values) that sufficient development is reached. The selection of the well development method (shall) be made by the rig geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

Overpumping and Backwashing - Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and gravel pack serves to remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

Surging with a Surge Plunger - A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is used to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

Compressed Air - Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level

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to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping the well is subsequently done with the air lift method.

High Velocity Jetting - In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 REFERENCES

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7.0 RECORDS

A critical part of monitoring well installation is recording of significant details and events in the field notebook. The Geologist must record the exact depths of significant hydrogeological features screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (Attachment C) shall be used which allows the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information (shall) include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. The documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded depending on whether the well is completed in overburden, in a confined layer, in bedrock with a cased well, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The Geologist shall calculate the annular space volume and have a general idea of the quantity of material needed to fill the annular space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in. Any problems with rig operation or down time shall be recorded and may determine the driller's final fee.

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ATTACHMENT A

TABLE 7-4 RELATIVE COMPATIBILITY OF RIGID WELL-CASING MATERIAL (PERCENT)

	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless steel 304	Stainless steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Miner Acid/High Solids	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials

- 1 Teflon®
- 2 Stainless Steel 316
- 3 Stainless Steel 304
- 4 PVC 1
- 5 Lo-Carbon Steel
- 6 Galvanized Steel
- 7 Carbon Steel
- * Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton®*	Silicone	Neoprene	Teflon®*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/High Solids	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials

- 1 Teflon®
 - 2 Polypropylene (PP)
 - 3 PVC flexible/PE linear
 - 4 Viton®
 - 5 PE Conventional
 - 6 Plexiglas/Lucite (PMM)
 - 7 Silicone/Neoprene
- Source: Barcelona et al., 1983
- * Trademark of DuPont

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ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength not critical.
Weight	Relatively heavier	Lightweight, floats in water
Cost	Relatively expensive	Relatively inexpensive
Corrosivity	Deteriorates more rapidly in corrosive water	Non-corrosive--may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated HC
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work in the field.
Preparation for Use	Should be steam-cleaned for organics sampling	Never use glue fittings--pipes should be threaded or pressure-fitted. Should be steam cleaned if used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized	May sorb or release organic substances.

* See also Attachment A.



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Applicability
EMG

Prepared
Earth Sciences

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Subject

EXCAVATION OF EXPLORATORY TEST PITS AND TRENCHES

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1.0 PURPOSE

This procedure describes methods for proper excavation of test pits and trenches.

2.0 SCOPE

These procedures give overall technical guidance and may be modified by site-specific requirements for field exploratory test pits and trenches. Conditions which would make trench excavation technically difficult (such as shallow water table), potentially dangerous (presence of explosive materials or underground utilities) or likely to cause even greater environmental problems (such as potential rupture of buried containerized wastes) would require modifications to the methods described herein and may prevent implementation of the exploratory excavation program. Furthermore, the costs and difficulties in disposing of potentially hazardous materials removed from test pits may constrain their use to areas where contamination potential is low. Consequently, the techniques described herein may be most applicable in areas of low apparent contamination and where potentially explosive materials are not expected to be present.

3.0 GLOSSARY

Trenches or test pit. - Open shallow excavations, typically longitudinal (if a trench) or rectangular (if a pit), to determine the shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by a machine, such as a backhoe, clamshell, trencher excavator, or bulldozer.

4.0 RESPONSIBILITIES

Site Manager - is responsible for determining, in consultation with other project personnel (geologist, geochemist, engineer), the need for test pits or trenches, their approximate locations, depths and sampling objectives.

Field Operation Leader (FOL) - is responsible for finalizing the location and depth of test pits/trenches based on site conditions and the site geologist's advice. The FOL is ultimately responsible for the proper construction and backfilling of test pits and trenches, including adherence to OSHA regulations if applicable (see Section 5.0).

Health and Safety Officer - responsible for air quality monitoring during test pit construction and sampling, to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. He/She may also be required to advise the FOL on other safety-related matters and mitigative measures to address potential physical hazards from unstable trench walls, puncturing of drums, or other hazardous objects, etc.

Site Geologist/Sampler - responsible for recording all information and data pertaining to the test pit excavation. Engineers, field technicians, or other properly trained personnel may also serve in this capacity.

5.0 PROCEDURES

5.1 APPLICABILITY

This subsection presents routine test pit or trench excavation techniques. Specialized techniques that are applicable only under certain conditions are not presented.

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During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise and control the method of excavation. All excavations that are deeper than 4 feet must be stabilized (before entry into the excavation) by bracing the pit sides using wooden or steel support structures. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments. In these cases, substantial air monitoring is required before entry, and appropriate respiratory gear and protective clothing is mandatory. There must be at least two persons present at the immediate site before entry by one of the investigators. The reader shall refer to OSHA regulations 29 CFR 1926, 29 CFR 1910.120, and 29 CFR 1910.134.

Excavations are generally not practical where a depth of more than about 15 feet is desired. They are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pits, providing that pumped water can be adequately stored or disposed. If data on soils at depths greater than 15 feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

5.2 TEST PIT AND TRENCH EXCAVATION

These procedures describe the methods for excavating and logging test pits and trenches to determine subsurface soil and rock conditions.

Test pits and trenches may be excavated by hand or by power equipment to permit detailed description of the nature and contamination of the in situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration
- The space required for efficient excavation
- The chemicals of concern
- The economics and efficiency of available equipment

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table, which is based on equipment efficiencies, can give a rough guide for design consideration:

Equipment	Typical Widths, in Feet
Trenching machine	2
Backhoe	2-6
Track dozer	10
Track loader	10
Excavator	10
Scraper	20

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Fifteen feet is considered to be the economical vertical limit of excavation. However, larger and deeper excavations have been used when special problems justified the expense.

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous waste materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. It may be necessary to record several elevations for irregular or sloping surfaces. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying. For regional studies test pits and trenches may be located by survey or by using existing topographic maps and plans.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, field conditions may necessitate revisions to the initial plans. The final depth and construction method shall be determined by the field geologist. The actual layout of each test pit, temporary staging area and spoils pile will be predicated on site conditions and wind direction at the time the test pit is made. Prior to excavation, the area can be surveyed by magnetometer or metal detector to identify the presence of underground utilities or drums.

The test pits and trenches shall be excavated in compliance with applicable safety regulations as specified by the health and safety officer.

If the depth exceeds 4 feet and people will be entering the pit or trench, Occupational Safety and Health Administration (OSHA) requirements must be met: Walls must be braced with wooden or steel braces, ladders must be in the hole at all times, and a temporary guardrail must be placed along the surface of the hole before entry. It is advisable to stay out of test pits as much as possible; if possible the required data or samples shall be gathered without entering the pit. Samples of leachate, groundwater, or sidewall soils can be taken with telescoping poles, etc.

Stabilization of the sides of test pits and trenches, when required, generally is achieved by sloping the walls at a sufficiently flat angle or by using sheeting. Benching or terracing can be used for deeper holes. Shallow excavations are generally stabilized by sheeting. Test pits excavated into fill are generally much more unstable than pits dug into natural in-place soil.

Sufficient space shall be maintained between trenches or pits to place soil that will be stockpiled for cover, as well as to allow access and free movement by haul vehicles and operating equipment. Excavated soil shall be stockpiled to one side in one location, preferably downwind, away from the edge of the pit to reduce pressure on the pit walls.

Dewatering may be required to assure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation dry. This is an important consideration for excavations in cohesionless material below the groundwater table. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific Work Plan.

The overland flow of water from excavated saturated soils and the erosion or sedimentation of the stockpiled soil shall be controlled. A temporary detention basin and a drainage system shall be planned to prevent the contaminated wastes from spreading, if necessary.

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5.3 BACKFILLING OF TRENCHES AND TEST PITS

Before backfilling, the onsite crew shall photograph all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the logbook. All photographs shall be indexed and maintained for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the field supervisor.

If a low permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the field supervisor (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.0 REFERENCES

NUS and CH₂MHill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, 1979. Excavation, Trenching and Shoring 29 CFR 1926.650-653.

7.0 RECORDS

Test pits and trenches shall be logged by the field geologist in accordance with Procedure GH-1.5.

Test pit logs shall contain a sketch of pit conditions (see Attachment A, Test Pit Log Form). In addition, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Test pit locations shall be documented by tying in the location of two or more nearby permanent landmarks (trees, house, fence, etc.) and shall be located on a site map. Surveying may also be required, depending on the requirements of each project. Other data to be recorded in the field logbook include the following:

- Name and location of job.
- Date of excavation.
- Approximate surface elevation.
- Total depth of excavation.
- Dimensions of pit.
- Method of sample acquisition.
- Type and size of samples.
- Soil and rock descriptions.
- Photographs.
- Groundwater levels.
- Organic gas or methane levels.
- Other pertinent information, such as waste material encountered.

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ATTACHMENT A

TEST PIT LOG		NUS CORPORATION		
PROJECT:		TEST PIT NO.:		
PROJECT NO.:		DATE:		
LOCATION:				
FIELD GEOLOGIST:				
DEPTH (ft.)	LITHOLOGY CHANGE (Depth, ft.)	MATERIAL DESCRIPTION	USCS	REMARKS
		(Soil Density / Consistency, Color)		
Test Pit Cross Section and/or Plan View				

REMARKS

PHOTO LOG

TEST PIT

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1.0 PURPOSE

The purpose of this procedure is to provide general reference information on the sampling of groundwater wells. The methods and equipment described are for the collection of water samples from the saturated zone of the subsurface.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for groundwater sampling. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Hydrogeologist or Geochemist - responsible for selecting and detailing the specific groundwater sampling techniques and equipment to be used, documenting these in the Project Operations Plan (POP), and properly briefing the site sampling personnel.

Site Geologist - The Site Geologist is primarily responsible for the proper acquisition of the groundwater samples. When appropriate, such responsibilities may be performed by other qualified personnel (engineers, field technicians).

Site Manager - The Site Manager is responsible for reviewing the sampling procedures used by the field crew and for performing in-field spot checks for proper sampling procedures.

5.0 PROCEDURES

5.1 GENERAL

To be useful and accurate, a groundwater sample must be representative of the particular zone of the water being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of testing in order to keep any changes in water quality parameters to a minimum.

Methods for withdrawing samples from completed wells include the use of pumps, compressed air, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of the groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water due to sampling techniques. In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with the groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. To safeguard against collecting non-representative stagnant water in a sample, the following approach shall be followed prior to sample acquisition:

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1. All monitoring wells shall be purged prior to obtaining a sample. Evacuation of three to five volumes is recommended for a representative sample. In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, evacuation prior to sample withdrawal is not as critical.
2. For wells that can be purged to dryness with the sampling equipment being used, the well shall be evacuated and allowed to recover prior to sample acquisition. If the recovery rate is fairly rapid, evacuation of more than one volume of water is preferred.
3. For high-yielding monitoring wells which cannot be evacuated to dryness, there is no absolute safeguard against contaminating the sample with stagnant water. One of the following techniques shall be used to minimize this possibility:
 - A submersible pump, intake line of a surface pump or bailer shall be placed just below the water surface when removing the stagnant water and lowered as the water level decreases. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. Once this is accomplished a bailer may be used to collect the sample for chemical analysis.
 - The inlet line of the sampling pump (or the submersible pump itself) shall be placed near the bottom of the screened section, and approximately one casing volume of water shall be pumped from the well at a rate equal to the well's recovery rate.

Stratification of contaminants may exist in the aquifer formation, both in terms of a concentration gradients due to mixing and dispersion processes in a homogeneous layer, and in layers of variable permeability into which a greater or lesser amount of the contaminant plume has flowed. Excessive pumping can dilute or increase the contaminant concentrations in the recovered sample compared to what is representative of the integrated water column at that point, and thus result in the collection of a non-representative sample.

5.2 SAMPLING, MONITORING, AND EVACUATION EQUIPMENT

Sample containers shall conform with EPA regulations for the appropriate contaminants.

The following equipment shall be on hand when sampling ground water wells:

- Sample packaging and shipping equipment - Coolers for sample shipping and cooling, chemical preservatives, appropriate packing containers and filler, ice, labels and chain-of-custody documents.
- Field tools and instrumentation - Thermometer; pH paper/meter; camera and film; tags; appropriate keys (for locked wells); engineers rule; water-level indicator; where applicable, specific-conductivity meter.
- Pumps
 - Shallow-well pumps--Centrifugal, pitcher, suction, or peristaltic pumps with droplines, air-lift apparatus (compressor and tubing) where applicable.
 - Deep-well pumps--submersible pump and electrical power generating unit, or air-lift apparatus where applicable.

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- Other sampling equipment - Bailers and monofilament line with tripod-pulley assembly (if necessary). Bailers shall be used to obtain samples for volatile organics from shallow and deep groundwater wells.
- Pails - Plastic, graduated.
- Decontamination solutions - Distilled water, Alconox, methanol, acetone.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, sterilized, and reused, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well flushing and sample collection.

5.3 CALCULATIONS OF WELL VOLUME

To insure that the proper volume of water has been removed from the well prior to sampling it is first necessary to know the volume of standing water in the well pipe. This volume can be easily calculated by the following method. Calculations shall be entered in the field logbook and on the field data form (Attachment A):

- Obtain all available information on well construction (location, casing, screens, etc.).
- Determine well or casing diameter.
- Measure and record static water level (depth below ground level or top of casing reference point).
- Determine depth of well (if not known from past records) by sounding using a clean, decontaminated weighted tape measure.
- Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
- Calculate one static well volume in gallons ($V = 0.163Tr^2$).

where:

- V = Static volume of well in gallons.
- T = Thickness of water table in the well measured in feet, i.e., linear feet of static water.
- r = Inside radius of well casing in inches.
- 0.163 = A constant conversion factor which compensates for the conversion of the casing radius from inches to feet, the conversion of cubic feet to gallons, and pi.

- Determine the minimum amount to be evacuated before sampling.

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5.4 EVACUATION OF STATIC WATER (PURGING)

5.4.1 General

The amount of flushing a well shall receive prior to sample collection will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of that aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately the well can be pumped until the parameters such as temperature, electrical conductance, and pH have stabilized. Onsite measurements of these parameters shall be recorded on the field data form.

For defining a contaminant plume, a representative sample of only a small volume of the aquifer is required. These circumstances require that the well be pumped enough to remove the stagnant water but not enough to induce significant groundwater flow from other areas. Generally three to five well volumes are considered effective for purging a well.

The site hydrogeologist, geochemist and risk assessment personnel shall define the objectives of the groundwater sampling program in the Work Plan, and provide appropriate criteria and guidance to the sampling personnel on the proper methods and volumes of well purging.

5.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment B provides guidance on the proper evacuation device to use for given sampling situations. Note that all of these techniques involve equipment which is portable and readily available.

5.4.2.1 Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of pipe with a sealed bottom (bucket-type bailer) or, as is more useful and favored, with a ball check-valve at the bottom. An inert line is used to lower the bailer and retrieve the sample.

Advantages of bailers include:

- Few limitations on size and materials used for bailers.
- No external power source needed.
- Bailers are inexpensive, and can be dedicated and hung in a well to reduce the chances of cross-contamination.
- There is minimal outgassing of volatile organics while the sample is in the bailer.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Transfer of sample may cause aeration.
- Use of bailers is physically demanding, especially in warm temperatures at protection levels above Level D.

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5.4.2.2 Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, peristaltic, and pitcher pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low volume pump (therefore not suitable for well purging) that uses rollers to squeeze a flexible tubing, thereby creating suction. This tubing can be dedicated to a well to prevent cross contamination. The pitcher pump is a common farm hand-pump.

These pumps are all portable, inexpensive and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause significant loss of dissolved gases and volatile organics. In addition, the complex internal components of these pumps may be difficult to decontaminate.

5.4.2.3 Gas-Lift Samplers

This group of samplers uses gas pressure either in the annulus of the well or in a venturi to force the water up a sampling tube. These pumps are also relatively inexpensive. Gas lift samplers are more suitable for well development than for sampling because the samples may be aerated, leading to pH changes and subsequent trace metal precipitation or loss of volatile organics.

5.4.2.4 Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. The operation principles vary and the displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include:

- They may have low delivery rates.
- Many models of these pumps are expensive.
- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding the impellers with some of these pumps.
- Decontamination of internal components is difficult and time-consuming.

5.5 SAMPLING

5.5.1 Sampling Plan

The sampling approach consisting of the following, shall be developed as part of the POP prior to the field work:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).

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- Intended number, sequence volumes, and types of samples. If the relative degrees of contamination between wells is unknown or insignificant, a sampling sequence which facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells as a result of the sampling procedures.
- Sample preservation requirements.
- Working schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirement for split samples, access problems, location of keys, etc.

5.5.2 Sampling Methods

The collection of a groundwater sample is made up of the following steps:

1. HSO or designee will first open the well cap and use volatile organic detection equipment (HNU or OVA) on the escaping gases at the well head to determine the need for respiratory protection.
2. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data in a well sampling data sheet (Attachment A); then calculate the fluid volume in the well pipe.
3. Calculate well volume to be removed as stated in Section 5.3.
4. Select appropriate purging equipment (see Attachment B). If an electric submersible pump with packer is chosen, go to Step 10.
5. Lower purging equipment or intake into the well to a short distance below the water level and begin water removal. Collect the purged water and dispose of it in an acceptable manner. Lower the purging device, as required, to maintain submergence.
6. Measure rate of discharge frequently. A bucket and stopwatch are most commonly used; other techniques include using pipe trajectory methods, weir boxes or flow meters.
7. Observe peristaltic pump intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics. Never collect volatile organics samples using a vacuum pump.
8. Purge a minimum of three-to-five casing volumes before sampling. In low permeability strata (i.e., if the well is pumped to dryness), one volume will suffice.
9. If sampling using a pump, lower the pump intake to midscreen or the middle of the open section in uncased wells and collect the sample. If sampling with a bailer, lower the bailer to sampling level before filling (this requires use of other than a 'bucket-type' bailer).

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Purged water shall be collected in a designated container and disposed of in an acceptable manner.

10. (For pump and packer assembly only). Lower assembly into well so that packer is positioned just above the screen or open section and inflate. Purge a volume equal to at least twice the screened interval or unscreened open section volume below the packer before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.
11. In the event that recovery time of the well is very slow (e.g., 24 hours), sample collection can be delayed until the following day. If the well has been bailed early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record in the logbook.
12. Add preservative if required. Label, tag, and number the sample bottle(s).
13. Replace the well cap. Make sure the well is readily identifiable as the source of the samples.
14. Pack the samples for shipping. Attach a custody seal to the front and back of the shipping package. Make sure that traffic reports and chain-of-custody forms are properly filled out and enclosed or attached.
15. Decontaminate all equipment

5.5.3 Sample Containers

For most samples and analytical parameters, either glass or plastic containers are satisfactory.

5.5.4 Preservation of Samples and Sample Volume Requirements

Sample preservation techniques and volume requirements depend on the type and concentration of the contaminant and on the type of analysis to be performed. Procedure SF-1.2 describes the sample preservation and volume requirements for most of the chemicals that will be encountered during hazardous waste site investigations. Procedure SA-4.3 describes the preservation requirement for microbial samples.

5.5.5 Handling and Transporting Samples

After collection, samples shall be handled as little as possible. It is preferable to use self-contained "chemical" ice (e.g., "blue ice") to reduce the risk of contamination. If water ice is used, it shall be bagged and steps taken to ensure that the melted ice does not cause sample containers to be submerged and thus possibly become cross-contaminated. All sample containers shall be enclosed in plastic bags or cans to prevent cross-contamination. Samples shall be secured in the ice chest to prevent movement of sample containers and possible breakage. Sample packing and transportation requirements are described in SA-6.2.

5.5.6 Sample Holding Times

Holding times (i.e. allowed time between sample collection and analysis) for routine samples are given in Procedure SF-1.2.

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5.6 RECORDS

Records will be maintained for each sample that is taken. The sample log sheet will be used to record the following information:

- Sample identification (site name, location, project number; sample name/number and location; sample type and matrix; time and date; sampler's identity).
- Sample source and source description.
- Purge data - prior to removal of each casing volume and before sampling, pH, electrical conductance, temperature, color, and turbidity shall be measured and recorded.
- Field observations and measurements (appearance; volatile screening; field chemistry; sampling method).
- Sample disposition (preservatives added; lab sent to, date and time; lab sample number, EPA Traffic Report or Special Analytical Services number, chain-of-custody number.
- Additional remarks - (e.g., sampled in conjunction with state, county, local regulatory authorities; samples for specific conductance value only; sampled for key indicator analysis; etc.).

5.7 CHAIN-OF-CUSTODY

Proper chain-of-custody procedures play a crucial role in data gathering. Procedure SA-6.1 describes the requirements for a correct chain-of-custody.

6.0 REFERENCES

U.S. EPA, 1980. Procedures Manual for Ground Water Monitoring at Solid Waste Disposal Facilities. Office of Solid Waste, United States Environmental Protection Agency, Washington, D.C.

Johnson Division, UOP, Inc. 1975. Ground Water and Wells, A Reference Book for the Water Well Industry. Johnson Division, UOP, Inc., Saint Paul, Minnesota.

Barcelona, M. J., J. P. Gibb and R. A. Miller, 1983. A guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling. ISWS Contract Report 327, Illinois State Water Survey, Champaign, Illinois.

Scalf, M. R., J. F. McNabb, W. J. Dunlap, R. L. Crosby and J. Fryberger, 1981. Manual of Ground Water Sampling Procedures. R. S. Kerr Environmental Research Laboratory, Office of Research and Development, U.S. EPA, Ada, Oklahoma.

Nielsen, D. M. and G. L. Yeates, 1985. A Comparison of Sampling Mechanisms Available for Small-Diameter Ground Water Monitoring Wells. Ground Water Monitoring Review 5:83-98.

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1.0 PURPOSE

This procedure describes methods and equipment commonly-used for collecting environmental samples of surface water and aquatic sediment for either on-site examination and chemical testing or for laboratory analysis.

2.0 SCOPE

The information presented in this guideline is generally applicable to all environmental sampling of surface waters (Section 5.3) and aquatic sediments (Section 5.4), except where the analyte(s) may interact with the sampling equipment. The collection of concentrated sludges or hazardous waste samples from disposal or process lagoons often requires methods, precautions and equipment different from those described herein.

3.0 GLOSSARY

Environmental Sample - low concentration sample typically collected offsite and not requiring DOT hazardous waste labeling or CLP handling as a high concentration sample.

Hazardous Waste Sample - medium to high concentration sample (e.g., source material, sludge, leachate) requiring DOT labeling and CLP handling as a high concentration sample.

4.0 RESPONSIBILITIES

Field Operations Leader - has overall responsibility for the correct implementation of surface water and sediment sampling activities, including review of the sampling plan with, and any necessary training of, the sampling technician(s). The actual collection, packaging, documentation (sample label and log sheet, chain-of-custody record, CLP traffic reports, etc.) and initial custody of samples will be the responsibility of the sampling technician(s).

5.0 PROCEDURES

5.1 INTRODUCTION

Collecting a representative sample from surface water or sediments is difficult because of water movement, stratification or patchiness. To collect representative samples, one must standardize sampling bias related to site selection; sampling frequency; sample collection; sampling devices; and sample handling, preservation, and identification.

Representativeness is a qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important quality not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been taken. Regardless of scrutiny and quality control applied during laboratory analyses, reported data are not better than the confidence that can be placed in the representativeness of the samples.

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5.2 DEFINING THE SAMPLING PROGRAM

Many factors must be considered in developing a sampling program for surface water or sediments including study objectives; accessibility; site topography; flow, mixing and other physical characteristics of the water body; point and diffuse sources of contamination; and personnel and equipment available to conduct the study. For waterborne constituents, dispersion depends on the vertical and lateral mixing within the body of water. For sediments, dispersion depends on bottom currents or flow characteristics, sediment characteristics (density, size) and geochemical properties (which affect an adsorption/desorption). The hydrologist developing the sampling plan must therefore, know not only the mixing characteristics of streams and lakes, but also must understand the role of fluvial-sediment transport, deposition, and chemical sorption.

5.2.1 Sampling Program Objectives

The objective of surface water sampling is to determine the surface water quality entering, leaving or remaining within the site. The scope of the sampling program must consider the sources and potential pathways for transport of contamination to or in a surface water body. Sources may include point sources (leaky tanks, outfalls, etc.) or nonpoint sources (e.g., spills). The major pathways for surface water contamination (not including airborne deposition are: (a) overland runoff; (b) leachate, influx to the waterbody; (c) direct waste disposal (solid or liquid) into the water body; and groundwater flow influx from upgradient. The relative importance of these pathways, and therefore the design of the sampling program, is controlled by the physiographic and hydrologic features of the site, the drainage basin(s) which encompass the site, and the history of site activities.

Physiographic and hydrologic features to be considered include slopes and runoff direction, areas of temporary flooding or pooling, tidal effects, artificial surface runoff controls such as berms or drainage ditches (and when they were constructed relative to site operation), and locations of springs, seeps, marshes, etc. In addition, the obvious considerations such as the location of man-made discharge points to the nearest stream (intermittent or flowing), pond, lake, estuary, etc., shall be considered.

A more subtle consideration in designing the sampling program is the potential for dispersion of dissolved or sediment-associated contaminants away from the source. The dispersion could lead to a more homogeneous distribution of contamination at low or possibly non-detectable concentrations. Such dispersion does not, however, always readily occur. For example, obtaining a representative sample of contamination from a main stream immediately below an outfall or a tributary is difficult because the inflow frequently follows a stream bank with little lateral mixing for some distance. Sampling alternatives to overcome this situation are: (1) move the site far enough downstream to allow for adequate mixing, or (2) collect integrated samples in a cross section. Also, nonhomogeneous distribution is a particular problem with regard to sediment-associated contaminants, which may accumulate in low-energy environments (coves, river bends, deep spots, or even behind boulders) near or distant from the source while higher-energy areas (main stream channels) near the source may show no contaminant accumulation.

The distribution of particulates within a sample itself is an important consideration. Many organic compounds are only slightly water soluble and tend to be absorbed by particulate matter. Nitrogen, phosphorus, and the heavy metals may also be transported by particulates. Samples will be collected with a representative amount of suspended material; transfer from the sampling device shall include transferring a proportionate amount of the suspended material.

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5.2.2 Location of Sampling Stations

Accessibility is the primary factor affecting sampling costs. The desirability and utility of a sample for analysis and description of site conditions must be balanced against the costs of collection as controlled by accessibility. Bridges or piers are the first choice for locating a sampling station on a stream because bridges provide ready access and also permit the sampling technician to sample any point across the stream. A boat or pontoon (with an associated increase in cost) may be needed to sample locations on lakes and reservoirs, as well as those on larger rivers. Frequently, however, a boat will take longer to cross a water body and will hinder manipulation of the sampling equipment. Wading for samples is not recommended unless it is known that contaminant levels are low so that skin contact will not produce adverse health effects. This provides a built in margin of safety in the event that wading boots or other protective equipment should fail to function properly. If it is necessary to wade into the water body to obtain a sample, the sampler shall be careful to minimize disturbance of bottom sediments and must enter the water body downstream of the sampling location. If necessary, the sampling technician shall wait for the sediments to settle before taking a sample.

Sampling in marshes or tidal areas may require the use of an all-terrain-vehicle (ATV). The same precautions mentioned above with regard to sediment disturbance will apply.

Under ideal and uniform contaminant dispersion conditions in a flowing stream, the same concentrations of each would occur at all points along the cross section. This situation is most likely downstream of areas of high turbulence. Careful site selection is needed in order to ensure, as nearly as possible, that samples are taken where uniform flow or deposition and good mixing conditions exist.

The availability of streamflow and sediment discharge records can be an important consideration in choosing sampling sites in streams. Streamflow data in association with contaminant concentration data are essential for estimating the total contaminant loads carried by the stream. If a gaging station is not conveniently located on a selected stream, the project hydrologist shall explore the possibility of obtaining streamflow data by direct or indirect methods.

5.2.3 Frequency of Sampling

The sampling frequency and the objectives of the sampling event will be defined by the work plan. For single-event site- or area-characterization sampling, both bottom material and overlying water samples shall be collected at the specified sampling stations. If valid data are available on the distribution of the contaminant between the solid and aqueous phases it may be appropriate to sample only one phase, although this is not often recommended. If samples are collected primarily for monitoring purposes, consisting of repetitive, continuing measurements to define variations and trends at a given location, water samples shall be collected at a pre-established and constant interval as specified in the work plan (often monthly or quarterly) and during droughts and floods. Samples of bottom material shall be collected from fresh deposits at least yearly, and preferably during both spring and fall seasons.

The variability in available water-quality data shall be evaluated before deciding on the number and collection frequency of samples required to maintain an effective monitoring program.

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5.3 SURFACE WATER SAMPLE COLLECTION

5.3.1 Streams, Rivers, Outfalls and Drainage Features (Ditches, Culverts)

Methods for sampling streams, rivers, outfalls and drainage features at a single point vary from the simplest of hand sampling procedures to the more sophisticated multipoint sampling techniques known as the equal-width-increment (EWI) method or the equal-discharge-increment (EDI) methods (see below).

Samples from different depths or cross-sectional locations in the water course taken during the same sampling episode shall be composited. However, samples collected along the length of the watercourse or at different times may reflect differing inputs or dilutions and therefore shall not be composited. Generally, the number and type of samples to be taken depend on the river's width, depth, discharge and on the suspended sediment the river's transports. The greater number of individual points that are sampled, the more likely that the composite sample will truly represent the overall characteristics of the water.

In small streams less than about 20 feet wide, a sampling site can generally be found where the water is well-mixed. In such cases, a single grab sample taken at mid-depth in the center of the channel is adequate to represent the entire cross-section.

For larger streams, at least one vertical composite shall be taken with one sample each from just below the surface, at mid-depth, and just above the bottom. The measurement of DO, pH, temperature, conductivity, etc., shall be made on each aliquot of the vertical composite and on the composite itself. For rivers, several vertical composites shall be collected.

5.3.2 Lakes, Ponds and Reservoirs

Lakes, ponds, and reservoirs have as much greater tendency to stratify than rivers and streams. The relative lack of mixing requires that more samples be obtained.

The number of water sampling sites on a lake, pond, or impoundment will vary with the size and shape of the basin. In ponds and small lakes, a single vertical composite at the deepest point may be sufficient. Similarly, the measurement of DO, pH, temperature, etc., is to be conducted on each aliquot of the vertical composite. In naturally-formed ponds, the deepest point may have to be determined empirically; in impoundments, the deepest point is usually near the dam.

In lakes and larger reservoirs, several vertical composites shall be composited to form a single sample. These verticals are often taken along a transect or grid. In some cases, it may be of interest to form separate composites of epilimnetic and hypolimnetic zones. In a stratified lake, the epilimnion is the thermocline which is exposed to the atmosphere. The hypolimnion is the lower, "confined" layer which is only mixed with the epilimnion and vented to the atmosphere during seasonal "overturn" (when density stratification disappears). These two zones may thus have very different concentrations of contaminants if input is only to one zone, if the contaminants are volatile (and therefore vented from the epilimnion but not the hypolimnion), or if the epilimnion only is involved in short-term flushing (i.e., inflow from or outflow to shallow streams). Normally, however, a composite consists of several verticals with samples collected at various depths.

In lakes with irregular shape and with bays and coves that are protected from the wind, separate composite samples may be needed to adequately represent water quality since it is likely that only poor mixing will occur. Similarly, additional samples are recommended where discharges, tributaries, land use characteristics, and other such factors are suspected of influencing water quality.

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Many lake measurements are now made in-situ using sensors and automatic readout or recording devices. Single and multiparameter instruments are available for measuring temperature, depth, pH, oxidation-reduction potential (ORP), specific conductance, dissolved oxygen, some cations and anions, and light penetration.

5.3.3 Estuaries

Estuarine areas are by definition zones where inland freshwaters (both surface and ground) mix with oceanic saline waters. Estuaries are generally categorized into three types dependent upon freshwater inflow and mixing properties. Knowledge of the estuary type is necessary to determine sampling locations:

- Mixed estuary - characterized by the absence of a vertical halocline (gradual or no marked increase in salinity in the water column) and a gradual increase in salinity seaward. Typically this type of estuary is shallow and is found in major freshwater sheetflow areas. Being well mixed, the sampling locations are not critical in this type of estuary.
- Salt wedge estuary - characterized by a sharp vertical increase in salinity and stratified, freshwater flow along the surface. In these estuaries the vertical mixing forces cannot override the density differential between fresh and saline waters. In effect, a salt wedge tapering inland moves horizontally, back and forth, with the tidal phase. If contamination is being introduced into the estuary from upstream, water sampling from the salt wedge may miss it entirely.
- Oceanic estuary - characterized by salinities approaching full strength oceanic waters. Seasonally, freshwater inflow is small with the preponderance of the fresh-saline water mixing occurring near, or at, the shore line.

Sampling in estuarine areas is normally based upon the tidal phases, with samples collected on successive slack tides (i.e. when the tide turns). Estuarine sampling programs shall include vertical salinity measurements at 1 to 5 foot increments coupled with vertical dissolved oxygen and temperature profiles.

5.3.4 Surface Water Sampling Equipment

The selection of sampling equipment depends on the site conditions and sample type required. The most frequently used samplers are:

- Open tube
- Dip sampler
- Hand pump
- Kemmerer
- Depth-Integrating Sampler

The dip sampler and the weighted bottle sampler are used most often.

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The criteria for selecting a sampler include:

- Disposable and/or easily decontaminated
- Inexpensive (if the item is to be disposed of)
- Ease of operation
- Nonreactive/noncontaminating - Teflon-coating, glass, stainless steel or PVC sample chambers are preferred (in that order)

Each sample (grab or each aliquot collected for compositing) shall be measured for:

- Specific conductance
- Temperature
- pH (optional)
- Dissolved oxygen (optional)

as soon as it is recovered. These analyses will provide information on water mixing/stratification and potential contamination.

5.3.4.1 Dip Sampling

Water is often sampled by filling a container either attached to a pole or held directly, from just beneath the surface of the water (a dip or grab sample). Constituents measured in grab samples are only indicative of conditions near the surface of the water and may not be a true representation of the total concentration that is distributed throughout the water column and in the cross section. Therefore, whenever possible it is recommended to augment dip samples with samples that represent both dissolved and suspended constituents and both vertical and horizontal distributions.

5.3.4.2 Weighted Bottle Sampling

A grab sample can also be taken using a weighted holder that allows a sample to be lowered to any desired depth, opened for filling, closed, and returned to the surface. This allows discrete sampling with depth. Several of these samples can be combined to provide a vertical composite. Alternatively, an open bottle can be lowered to the bottom and raised to the surface at a uniform rate so that the bottle collects sample throughout the total depth and is just filled on reaching the surface. The resulting sample using either method will roughly approach what is known as a depth-integrated sample.

A closed weighted bottle sampler consists of a capped glass or plastic bottle, a weight and/or holding device, and lines to open the stopper and lower or raise the bottle. The procedure for sampling is:

- Gently lower the sampler to the desired depth so as not to remove the stopper prematurely (watch for bubbles).
- Pull out the stopper with a sharp jerk of the sampler line.
- Allow the bottle to fill completely, as evidenced by the absence of air bubbles.
- Raise the sampler and cap the bottle.
- Decontaminate the outside of the bottle. The bottle can be used as the sample container (as long as original bottle is an approved container).

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5.3.4.3 Kemmerer

If samples are desired at a specific depth, and the parameters to be measured do not require a Teflon coated sampler, a standard Kemmerer sampler may be used. The Kemmerer sampler is a brass, stainless steel or acrylic cylinder with rubber stoppers that leave the ends open while being lowered in a vertical position to allow free passage of water through the cylinder. "Messenger" is sent down the line when the sampler is at the designated depth, to cause the stoppers to close the cylinder, which is then raised. Water is removed through a valve to fill sample bottles.

5.3.5 Surface Water Sampling Techniques

Most samples taken during site investigations are grab samples. Typically, surface water sampling involves immersing the sample container in the body of water; however, the following suggestions are made to help ensure that the samples obtained are representative of site conditions:

- The most representative samples are obtained from mid-channel at 0.6 stream depth in a well-mixed stream.
- Even though the containers used to obtain the samples are previously laboratory cleaned, it is suggested that the sample container be rinsed at least once with the water to be sampled before the sample is taken.
- For sampling running water, it is suggested that the farthest downstream sample be obtained first and that subsequent samples be taken as one works upstream. Work from zones suspected of low contamination to zones of high contamination.
- To sample a pond or other standing body of water, the surface area may be divided into grids. A series of samples taken from each grid is combined into one sample, or several grids are selected at random.
- Care should be taken to avoid excessive agitation of the water that results in the loss of volatile constituents.
- When obtaining samples in 40 ml septum vials for volatile organics, analysis, it is important to exclude any air space in the top of the bottle and to be sure that the Teflon liner faces in after the bottle is filled and capped. The bottle can be turned upside down to check for air bubbles.
- Do not sample at the surface, unless sampling specifically for a known constituent which is immiscible and on top of the water. Instead, the sample container should be inverted, lowered to the approximate depth, and held at about a 45-degree angle with the mouth of the bottle facing upstream.

5.4 SEDIMENT SAMPLING

5.4.1 General

Sediment samples are usually collected at the same verticals at which water samples were collected. If only one sediment sample is to be collected, the site shall be approximately at the center of water body. Generally, the coarser grained sediments are deposited near the headwaters of the reservoir. Bed sediments near the center will be composed of fine-grained materials which may, because of their lower porosity and greater surface area available for adsorption, contain greater concentrations

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of contaminants. The shape, flow pattern, bathymetry (depth distribution), and water circulation patterns must all be considered when selecting sediment sampling sites. In streams, areas likely to have sediment accumulation (bends, behind islands or boulders, quiet shallow areas or very deep, low-velocity areas) shall be sampled while areas likely to show net erosion (high-velocity, turbulent areas) and suspension of fine solid materials shall be avoided.

Chemical constituents associated with bottom material may reflect an integration of chemical and biological processes. Bottom samples reflect the historical input to streams, lakes, and estuaries with respect to time, application of chemicals, and land use. Bottom sediments (especially fine-grained material) may act as a sink or reservoir for adsorbed heavy metals and organic contaminants (even if water column concentrations are below detection limits). It is therefore important to minimize the loss of low-density "fines" during any sampling process.

5.4.2 Sampling Equipment and Techniques

A bottom-material sample may consist of a single scoop or core or may be a composite of several individual samples in the cross section. Sediment samples may be obtained using on-shore or off-shore techniques.

When boats are used for sampling, life preservers must be provided and two individuals must undertake the sampling. An additional person shall remain on-shore in visual contact at all times.

The following samplers may be used to collect bottom materials:

- Scoop sampler
- Dredge samplers

5.4.2.1 Scoop Sampler

A scoop sampler consists of a pole to which a jar or scoop is attached. The pole may be made of bamboo, wood or aluminum and be either telescoping or of fixed length. The scoop or jar at the end of the pole is usually attached using a clamp.

If the water body can be sampled from the shore or if it can be waded, the easiest and "cleanest" way to collect a sediment sample is to use a scoop sampler. This reduces the potential for cross-contamination. This method is accomplished by reaching over or wading into the water body and, while facing upstream (into the current), scooping in the sample along the bottom in the upstream direction. It is very difficult not to disturb fine-grained materials of the sediment-water interface when using this method.

5.4.2.2 Dredges

Dredges are generally used to sample sediments which cannot easily be obtained using coring devices (i.e., coarse-grained or partially-cemented materials) or when large quantities of materials are required. Dredges generally consist of a clam shell arrangement of two buckets. The buckets may either close upon impact or be activated by use of a messenger. Most dredges are heavy (up to several hundred pounds) and require use of a winch and crane assembly for sample retrieval. There are three major types of dredges: Peterson, Eckman and Ponar dredges.

The Peterson dredge is used when the bottom is rocky, in very deep water, or when the flow velocity is high. The dredge shall be lowered very slowly as it approaches bottom, because it can force out and miss lighter materials if allowed to drop freely.

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The Eckman dredge has only limited usefulness. It performs well where bottom material is unusually soft, as when covered with organic sludge or light mud. It is unsuitable, however, for sandy, rocky, and hard bottoms and is too light for use in streams with high flow velocities.

The Ponar dredge is a Peterson dredge modified by the addition of side plates and a screen on the top of the sample compartment. The screen over the sample compartment permits water to pass through the sampler as it descends thus reducing the "shock wave" and permitting direct access to the secured sample without opening the closed jaws. The Ponar dredge is easily operated by one person in the same fashion as the Peterson dredge. The Ponar dredge is one of the most effective samplers for general use on all types of substrates. Access to the secured sample through the covering screens permits subsampling of the secured material with coring tubes or Teflon scoops, thus minimizing the change of metal contamination from the frame of the device.

6.0 REFERENCES

Feltz, H. R., 1980. Significance of Bottom Material Data in Evaluating Water Quality in Contaminants and Sediments. Ann Arbor, Michigan, Ann Arbor Science Publishers, Inc., V. 1, p. 271-287.

Kittrell, F. W., 1969. A Practical Guide to Water Quality Studies of Streams. U.S. Federal Water Pollution Control Administration, Washington, D.C., 135p.

U.S. EPA, 1980. Standard Operating Procedures and Quality Assurance Manual. Water Surveillance Branch, USEPA Surveillance and Analytical Division, Athens, Georgia.

U.S. Geological Survey, 1977. National Handbook of Recommended Methods for Water-Data Acquisition. Office of Water Data Coordination, USGS, Reston, Virginia.

7.0 ATTACHMENTS

None.

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4.0 RESPONSIBILITIES

Field Operations Leader - Responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record and maintaining custody of samples until they are relinquished to another custodian, to the shipper, or to the common carrier.

Remedial Investigation Leader - Responsible for determining that chain-of-custody procedures have been met by the sample shipper and analytical laboratory.

5.0 PROCEDURES

5.1 OVERVIEW

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is what it is represented to be. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom and, secondly, provide security for the evidence as it is moved and/or passes from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain of possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

5.2 SAMPLE IDENTIFICATION

The method of identification of a sample depends on the type of measurement or analysis performed. When in-situ measurements are made, the data are recorded directly in bound logbooks or other field data records, with identifying information.

5.2.1 Sample Label

Samples, other than in-situ measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling Plan. Each sample container is identified by a sample label (see Attachment B). Sample labels are provided by the PMO. The information recorded on the sample label includes:

- **Project:** EPA Work Assignment Number (can be obtained from the Sampling Plan).
- **Station Location:** The unique sample number identifying this sample (can be obtained from the Sampling Plan).
- **Date:** A six-digit number indicating the day, month, and year of sample collection; e.g., 12/21/85.
- **Time:** A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- **Medium:** Water, soil, sediment, sludge, waste, etc.

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- **Concentration:** The expected concentration (i.e., low, medium, high).
- **Sample Type:** Grab or composite.
- **Preservation:** Type of preservation added and pH levels.
- **Analysis:** VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- **Sampled By:** Printed name of the sampler.
- **Case Number:** Case number assigned by the Sample Management Office.
- **Traffic Report Number:** Number obtained from the traffic report labels.
- **Remarks:** Any pertinent additional information.

Using just the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site).

5.2.2 Sample Identification Tag

A Sample Identification Tag (Attachment F) must also be used for samples collected for CLP (Contract Laboratory Program) analysis. The Sample Identification Tag is a white, waterproof paper label, approximately 3-by-6 inches, with a reinforced eyelet, and string or wire for attachment to the neck of the sample bottle. The Sample Tag is a controlled document, and is provided by the regional EPA office. Following sample analysis, the Sample Tag is retained by the laboratory as evidence of sample receipt and analysis.

The following information is recorded on the tag:

- **Project Code:** Work Assignment Number.
- **Station Number:** The middle portion of the Station Location Number, (between the hyphens).
- **Month/Day/Year:** Same as Date on Sample Label.
- **Time:** Same as Time on Sample Label.
- **Designate - Comp/Grab:** Composite or grab sample.
- **Station Location:** Same as Station Location on Sample Label.
- **Samplers:** Same as Sampled By on Sample Label.
- **Preservative:** Yes or No.
- **Analyses:** Check appropriate box(es).

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- **Remarks:** Same as Remarks on Sample Label (make sure the Case Number and Traffic Report numbers are recorded).
- **Lab Sample Number:** For laboratory use only.

The tag is then tied around the neck of the sample bottle.

If the sample is to be split, it is aliquoted into similar sample containers. Identical information is completed on the label attached to each split.

Blank, duplicate, or field spike samples shall not be identified as such on the label, as they may compromise the quality control function. Sample blanks, duplicates, spikes, and splits are defined in Procedure SA-6.6.

5.3 CHAIN-OF-CUSTODY PROCEDURES

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed of.

5.3.1 Field Custody Procedures

- Samples are collected as described in the site-specific Sampling Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the sample log sheet and Chain-of-Custody Record exactly.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once developed, the photographic prints shall be serially numbered, corresponding to the logbook descriptions.
- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions, e.g., a logbook notation would explain that a pencil was used to fill out the sample label because a ballpoint pen would not function in freezing weather.

5.3.2 Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. Chain-of-Custody Record Forms used in EPA Regions I-IV are shown in Attachments A through D. The appropriate form shall be obtained from the EPA Regional Office. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as follows:

- Enter header information (project number, samplers, and project name -- project name can be obtained from the Sampling Plan).
- Sign, date, and enter the time under "Relinquished by" entry.

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- Enter station number (the station number is the middle portion of the station location number, between the hyphens).
- Check composite or grab sample.
- Enter station location number (the same number as the station location on the tag and label).
- Enter the total number of containers per station number and the type of each bottle.
- Enter either the inorganic traffic report number, the organic traffic report number, or the SAS number for each station number in the remarks column.
- Enter the tag number from the bottom of the sample identification tag in the remarks column for each station location.
- Make sure that the person receiving the sample signs the "Received by" entry, or enter the name of the carrier (e.g., UPS, Federal Express) under "Received by." Receiving laboratory will sign "Received for Laboratory by" on the lower line and enter the date and time.
- Enter the bill-of-lading or Federal Express airbill number under "Remarks," in the bottom right corner, if appropriate.
- Place the original (top, signed copy) of the Chain-of-Custody Record Form in the appropriate sample shipping package. Retain the pink copy with field records.
- Sign and date the custody seal, a 1- by 3-inch white paper label with black lettering and an adhesive backing. Attachment G is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals are provided by ZPMO on an as-needed basis.
- Place the seal across the shipping container opening so that it would be broken if the container is opened.
- Complete other carrier-required shipping papers.

The custody record is completed using black waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the sample container (enclosed with other documentation in a plastic zip-lock bag). As long as custody forms are sealed inside the sample container and the custody seals are intact, commercial carriers are not required to sign off on the custody form.

If sent by mail, the package will be registered with return receipt requested. If sent by common carrier or air freight, proper documentation must be maintained.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

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5.3.3 Receipt for Samples Form

Whenever samples are split with a private party or government agency, a separate Receipt for Samples Record Form is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the party or agency shall require the signature of a representative of the appropriate party acknowledging receipt of the samples. If a representative is unavailable or refuses to sign, this is noted in the "Received by" space. When appropriate, as in the case where the representative is unavailable, the custody record shall contain a statement that the samples were delivered to the designated location at the designated time. This form must be completed and a copy given to the owner, operator, or agent-in-charge even if the offer for split samples is declined. The original is retained by the Field Operations Leader.

6.0 REFERENCES

U.S. EPA, 1984. User's Guide to the Contract Laboratory Program, Office of Emergency and Remedial Response, Washington, D.C.

7.0 ATTACHMENTS

Attachment A - Chain-of-Custody Record Form for use in Region I
Attachment B - Chain-of-Custody Record Form for use in Region II
Attachment C - Chain-of-Custody Record Form for use in Region III
Attachment D - Chain-of-Custody Record Form for use in Region IV
Attachment E - Sample Label
Attachment F - Sample Identification Tag
Attachment G - Chain-of-Custody Seal

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**ENVIRONMENTAL
TECHNOLOGIES GROUP**

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Earth Sciences

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Subject
FIELD DOCUMENTATION

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1.0 PURPOSE

The purpose of this standard operating procedure is to delineate the field data record forms, logs and reports generally initiated and maintained for documenting ETG field activities.

2.0 SCOPE

Documents presented within this procedure shall be used for all ETG field projects, as applicable. Exceptions may include other additional documents required specifically by contract.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Site Manager - The Site Manager releases the site logbook to the Field Operations Leader or other person responsible for the direction of on-site activities (e.g., Reconnaissance Survey Team Leader, Sampling Team Leader). Also, responsible for placing all forms used in site activities, field reports, and upon the completion of field work the site logbook in the permanent site file.

Field Operations Leader - The Field Operations Leader is responsible for ensuring that the site logbook and the appropriate forms and field reports illustrated in this guideline are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 SITE LOGBOOK

5.1.1 General

The site logbook is a controlled document which records all major on-site activities. At a minimum, the following activities/events shall be recorded in the site logbook:

- Arrival/departure of site visitors
- Arrival/departure of equipment
- Sample pickup (chain-of-custody form numbers, carrier, time)
- Sampling activities/sample logsheet numbers
- Start or completion of borehole/trench/monitoring well installation or sampling activities
- Health and Safety issues

The site logbook is initiated at the start of the first on-site activity (e.g., initial reconnaissance survey). Entries are made for every day that on-site activities take place which involve HALLIBURTON NUS or subcontractor personnel. One current site logbook is maintained per site. The site logbook becomes part of the permanent site file.

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The cover of each site logbook contains the following information:

- Project Name
- HALLIBURTON NUS Project Number
- Site Manager's Name
- Sequential Book Number
- Start Date
- End Date

Daily entries into the logbook may contain a variety of information. At the beginning of each day the following information must be recorded:

- Date
- Start time
- Weather
- All field personnel present
- Any visitors present

During the day, a summary of all site activities and level of personal protection shall be recorded in the logbook. The information need not duplicate that recorded in other field notebooks (e.g., sample logbook, Site Geologist's notebook, Health and Safety Officer's notebook, etc.), but shall summarize the contents of these other notebooks and refer to the page locations in these notebooks for detailed information. An example of a site logbook page is shown in Attachment A.

The sample logsheet for each sample collected (see Procedure _____) must be referenced. If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the notebook and page number(s) on which they are recorded (see Attachment A).

All entries shall be made in black pen. No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook must be signed. It must also be signed by the Field Operations Leader or responsible site leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they are numbered to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions are entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques shall be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Adequate logbook notation and receipts may be used to account for routine film processing. Once processed, the slides of photographic prints shall be serially numbered and labeled according to the logbook descriptions.

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5.2 FORMS USED IN RI ACTIVITIES

Table 1 lists the forms illustrated in this procedure. Forms may be altered or revised for project-specific needs, with proper client notification.

5.2.1 Sample Collection, Labeling, Shipment and Request for Analysis

5.2.1.1 Sample Label

The sample label is a 2-by 4-inch white label with black lettering and an adhesive backing. Attachment B-1 is an example of a sample label. These labels are required on every sample but are not controlled documents. Guidelines for filling out sample labels are contained in _____.

5.2.1.2 Chain-of-Custody Record Form

The Chain-of-Custody Record Form accompanies a sample (or group of samples) as it is transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis, whether on-site or off-site. Attachment B-2 illustrates a Chain-of-Custody Record form used by HALLIBURTON NUS.

5.2.1.3 Chain-of-Custody Seal

Attachment B-3 is an example of a custody seal. The Custody seal is a 1-by 3-inch adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. It is used whenever samples are shipped with an accompanying Chain-of-Custody Record form. Procedure _____ describes the procedures for using chain-of-custody seals.

5.2.1.4 Sample Log Sheet

A Sample Log Sheet is a notebook (3-ring binder) page that is used to record specified types of data while sampling. Attachments B-4 to B-7 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems encountered during sampling. Guidelines for filling out the Sample Log Sheet are contained in _____.

5.2.2 Geohydrological and Geotechnical Forms

5.2.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 should be filled out for each round of water level measurements at a site.

5.2.2.2 Data Sheet for Pumping Test (Pumping Well)

During the performance of a pumping test, a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

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TABLE 1

TECHNICAL FORMS IN CURRENT USE FOR REMEDIAL INVESTIGATIONS

Attachment Number/Description		Form Usage Described in SOP Number
B-1	Sample Label	SA-6.1
B-2	Chain-of-Custody Record	SA-6.1
B-3	Chain-of-Custody Seal	SA-6.6
B-4	Groundwater Sample Log Sheet	SA-6.6
B-5	Soil Sample Log Sheet	SA-6.6
B-6	Surface Water Sample Log Sheet	SA-6.6
B-7	Container Sample Log Sheet	SA-6.6
C-1	Groundwater Level Measurement Sheet	GH-2.5
C-2	Pumping Test Data Sheet	GH-2.3
C-3	Hydraulic Conductivity Testing Data Sheet	GH-2.4
C-4	Packer Testing Report Form	GH-2.2
C-5	Summary Log of Boring	GH-1.5
C-6	Overburden Monitoring Well Construction Sheet	GH-1.5
C-7	Confining Layer Monitoring Well Construction Sheet	GH-1.5
C-8	Bedrock (Open Hole) Monitoring Well Construction Sheet	GH-1.5
C-9	Bedrock (Well Installed) Monitoring Well Construction Sheet	GH-1.5
C-10	Bedrock (Well Installed) Monitoring Well Construction Sheet	GH-1.5
C-11	Test Pit Log	GH-1.8
D-1	Equipment Calibration Log	---

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5.2.2.3 Data Sheet for Pumping Test (Observation Well) or In-Situ Hydraulic Conductivity Test

This data sheet (Attachment C-3) is similar to that described in Section 5.2.2.2. However, somewhat different data must be recorded for pumping test observation wells and in-situ hydraulic conductivity tests, as shown on this sheet.

5.2.2.4 Packer Test Reporting Forms

A packer test reporting form shown in Attachment C-4 is used for collecting data when conducting packer tests during monitoring well drilling.

5.2.2.5 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring (Attachment C-5) is used for this purpose. In addition, if volatile organics are monitored on cores, samples or cuttings from the borehole (using HNU or OVA detectors), the results are entered on the boring log at the appropriate depth. The boring log also provides space for entry of the laboratory sample number and the concentration of a few key analytical results. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.2.2.6 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter sand and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-6 through C-10). The Monitoring Well Construction Details Form is not a controlled document. Guidelines on completing this form are contained in _____.

5.2.2.7 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-11) must be filled out by the responsible field geologist or sampling technician.

5.2.3 Equipment Calibration and Maintenance Forms

5.2.3.1 Equipment Calibration Log

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, other infrequent. Some are calibrated by the manufacturer, other by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D-1) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device.

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5.3 FIELD REPORTS

The reports described herein are to be used during field investigations, but do not replace or take precedence over project-specific or subcontractor-specific required reports.

These reports serve several purposes:

- To maintain a written record of major events/accomplishments/problems related to the field work.
- To allow ongoing monitoring of the actual progress of field tasks in comparison to the planned schedule, and to allow timely corrective action (if required).
- To inform Site Managers of progress/accomplishments for inclusion in The Monthly Project Tracking System.

5.3.1 Program Design

The primary means of recording onsite activities is the site logbook (see Procedure _____) and other field logbooks (e.g. geologists notebook, health and safety officer's logbook, sample logbooks). However, these logbooks and notebooks usually contain extremely detailed information which is required for data interpretation or documentation, but not for tracking and reporting of progress. Furthermore, the field logbooks remain onsite for extended periods of time and are thus not accessible for review by project management. The reports described in this procedure are, in essence, simplified summaries of the logbooks, which are designed to provide only the information needed by project management to keep informed of the progress of field activities.

5.3.2 Daily Activities Report

5.3.2.1 Description

The Daily Activities Report documents the activities and progress for each day's field work. This report is filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.3.2.2 Responsibilities

It is the responsibility of the rig geologist to complete the report and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.3.2.3 Submittal and Approval

At the end of the shift, the rig geologist submits the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The reports are retained by the FOL for use in preparing the site logbook and weekly Field Summaries, and are submitted to the Site Manager weekly along with the Weekly Field Summary.

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5.3.3 Field Trip Summary

5.3.3.1 Description

The Field Trip Summary is an abstract of the Site Logbook, summarizing the major activities onsite for a particular week or field cycle (e.g., 10 days). It should be organized on a day-by-day basis, and contain the following information at a minimum (see Attachment B):

- Date (week ending)
- Personnel onsite (contractor, subcontractors, visitors)
- Weather conditions encountered during the week
- Site activities
- Number and type of samples collected (including C.O.C. form numbers)
- Issues impacting progress of the project.

5.3.3.2 Responsibilities

The Field Operations Leader or responsible individual onsite if not the FOL (e.g., geophysics team leader, sampling team leader) is responsible for completing the Weekly Field Summary at the end of each week of ongoing site activity, or at the completion of an activity (if no further activity will take place during that week).

5.3.3.3 Submittal and Approval

The summary, along with Daily Activities Reports, Health & Safety Officer's Reports, and any other documentation, must be delivered or sent to the Site Manager at the end of each week.

The Field Trip Summary is an internal informational document and is not subject to project management review or approval.

6.0 REFERENCES

None.

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7.0 ATTACHMENTS

Attachment A - Typical Site Logbook Entry
 Attachment B-1 - Sample Label
 Attachment B-2 - Chain-of-Custody Record From, Region III
 Attachment B-3 - Chain-of-Custody Seal
 Attachment B-4 - Groundwater Sample Log Sheet Form
 Attachment B-5 - Soil Sample Log Sheet Form
 Attachment B-6 - Surface Water Sample Log Sheet Form
 Attachment B-7 - Container Sample Log Sheet Form
 Attachment C-1 - Groundwater Level Measurement Sheet
 Attachment C-2 - Pumping Test Data Sheet
 Attachment C-3 - Hydraulic Conductivity Testing Data Sheet
 Attachment C-4 - Packer Testing Report Form
 Attachment C-5 - Summary Log of Boring
 Attachment C-6 - Overburden Monitoring Well Construction Sheet
 Attachment C-7 - Confining Layer Monitoring Well Construction Sheet
 Attachment C-8 - Bedrock (Open Hole) Monitoring Well Construction Sheet
 Attachment C-9 - Bedrock (Well Installed) Monitoring Well Construction Sheet
 Attachment C-10 - Bedrock (Well Installed) Monitoring Well Construction Sheet
 Attachment C-11 - Test Pit Log Form
 Attachment D-1 - Equipment Calibration Log
 Attachment E - Rig Shift Report
 Attachment F - Field Trip Summary Report (2 pages)

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**ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY**

START TIME: _____ DATE: _____

SITE LEADER: _____

PERSONNEL:

HALLIBURTON NUS

DRILLER

EPA

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenny and fire hoses were set up.
2. Drilling activities at well _____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4 inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page _____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manager arrives on-site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit _____ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel offsite, gate locked.

Field Operations Leader

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ATTACHMENT B-1

SAMPLE LABEL


PROJECT: _____			
STATION LOCATION: _____			
DATE: ____/____/____		TIME: _____ hrs.	
MEDIA: WATER <input type="checkbox"/>	SOIL <input type="checkbox"/>	SEDIMENT <input type="checkbox"/>	<input type="checkbox"/>
CONCENTRATION: LOW <input type="checkbox"/>		MEDIUM <input type="checkbox"/>	HIGH <input type="checkbox"/>
TYPE: GRAB <input type="checkbox"/>		COMPOSITE <input type="checkbox"/>	
ANALYSIS		PRESERVATION	
VOA <input type="checkbox"/>	BNAs <input type="checkbox"/>	Cool to 4°C	<input type="checkbox"/>
PCBs <input type="checkbox"/>	PESTICIDES <input type="checkbox"/>	HNO ₃ to pH <2	<input type="checkbox"/>
METALS: TOTAL <input type="checkbox"/>	DISSOLVED <input type="checkbox"/>	NaOH to pH >12	<input type="checkbox"/>
CYANIDE <input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>
Sampled by: _____			
Case No. _____		Traffic Report No.: _____	
Remarks:			

[illegible]

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ATTACHMENT B-3

CHAIN-OF-CUSTODY SEAL

CUSTODY SEAL _____ Date _____ Signature		CUSTODY SEAL _____ Date _____ Signature
--	---	--

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ATTACHMENT B-4

SAMPLE LOG SHEET

Page ____ of ____



- ☐ Monitoring Well Data
☐ Domestic Well Data
☐ Other _____

Case # _____

By _____

Project Site Name _____

Project Site Number _____

HALLIBURTON NUS Source No. _____

Source Location _____

Total Well Depth:		Purge Data			
Well Casing Size and Depth:	Volume	pH	S.C.	Temp. (°C)	Color & Turbidity
Static Water Level:					
One Casing Volume:					
Start Purge (hrs.):					
End Purge (hrs.):					
Total Purge Time (min.):					
Total Amount Purged (gal.):					
Monitor Reading:					
Purge Method:					
Sample Method:					
Depth Sampled:					
Sample Date and Time:	Sample Data				
	pH	S.C.	Temp. (°C)	Color & Turbidity	
Sampled By:					
Signature(s):	Observations/Notes:				
Type of Sample					
<input type="checkbox"/> Low Concentration					
<input type="checkbox"/> High Concentration					
<input type="checkbox"/> Grab					
<input type="checkbox"/> Composite					
<input type="checkbox"/> Grab - Composite					
Analysis:	Preservative:	Organic		Inorganic	
		Traffic Report #			
		Tag #			
		AB #			
		Date Shipped			
		Time Shipped			
		Lab			
		Volume			

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ATTACHMENT B-6

SAMPLE LOG SHEET



- ☐ Spring
☐ Lake
☐ Stream
☐ Other _____

Page ____ of ____
 Case # _____
 By _____

Project Site Name _____ Project Site Number _____

HALLIBURTON NUS Source No. _____ Source Location _____

Sample Method:		Sample Data			
		pH	S.C.	Temp. (°C)	Color & Turbidity
Depth Sampled:					
Sample Date & Time:					
Sampled By:					
Signature(s):					
Type of Sample <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration <input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Grab - Composite					
Analysis:	Preservative:				
			Organic	Inorganic	
Traffic Report #					
Tag #					
AB #					
Date Shipped					
Time Shipped					
Lab					
Volume					

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ATTACHMENT B-7

SAMPLE LOG SHEET



☐ Container Data

Page _____ of _____

Case # _____

By _____

Project Site Name _____

Project Site Number _____

HALLIBURTON NUS Source No. _____

Source Location _____

Container Source	Container Description		
<input type="checkbox"/> Drum <input type="checkbox"/> Bung Top <input type="checkbox"/> Lever Lock <input type="checkbox"/> Bolted Ring <input type="checkbox"/> Other _____ <input type="checkbox"/> Bag/Sack <input type="checkbox"/> Tank <input type="checkbox"/> Other _____	Color _____ Condition _____ Markings _____ Vol. of Contents _____ Other _____		
Disposition of Sample	Sample Description		
<input type="checkbox"/> Container Sampled <input type="checkbox"/> Container opened but not sampled. Reason: _____ <input type="checkbox"/> Container not opened. Reason: _____	Layer 1 Phase _____ Color _____ Viscosity _____ % of Total _____ Volume _____ Other _____	Layer 2 <input type="checkbox"/> Sol. <input type="checkbox"/> Liq. <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H _____ _____	Layer 3 <input type="checkbox"/> Sol. <input type="checkbox"/> Liq. <input type="checkbox"/> L <input type="checkbox"/> M <input type="checkbox"/> H _____ _____
Monitor Reading:	Type of Sample		
Sample Method:	<input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration	<input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Grab - Composite	
Sample Date & Time:		Organic	Inorganic
	Traffic Report #		
Sampled By:	Tag #		
Signature(s):	AB #		
	Date Shipped		
Analysis:	Time Shipped		
	Lab		
	Volume		

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ATTACHMENT C-1

GROUNDWATER LEVEL MEASUREMENT SHEET

	<u>LOCATION</u>
Project Name: _____	Municipality: _____
Project No.: _____	County: _____
Personnel: _____	State: _____
Date: _____	Street or _____
	Map Location _____
	(If Off-Site) _____

	<u>WEATHER CONDITIONS</u>
Temperature Range: _____	Equipment No.: _____
Precipitation: _____	Equipment Name: _____
Barometric Pressure: _____	Latest Calibration Date: _____
Tidally-Influenced: <input type="checkbox"/> Yes <input type="checkbox"/> No	

Well or Piezometer Number	Date/Time	Elevation of Reference Point (Feet)*	Water Level Indicator Reading (Feet)*	Adjusted Depth (Feet)*	Groundwater Elevation (Feet)*

* All elevations to nearest 0.01 foot.

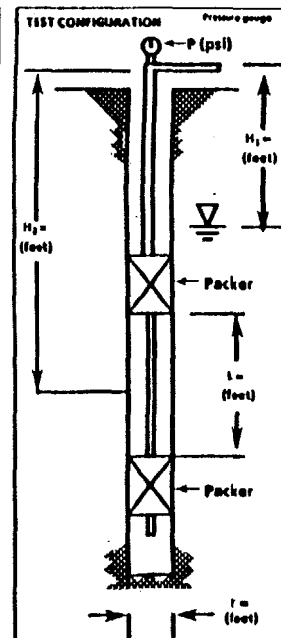
ATTACHMENT C-4
PACKER TEST REPORT

PROJECT: _____ PROJECT NO.: _____ TEST NO.: _____ PAGE _____ OF _____
BORING NO.: _____ CASING DEPTH: _____ CONTRACTOR: _____ STATIC WATER LEVEL _____
TEST INTERVAL: _____ BY: _____ CHECKED: _____ PACKER PRESSURE _____

[illegible]

CP = $(1/2 + L) \ln(L/r) (70,315.5)$
7.48 Gallons = 1 Ft³
1 psi = 2.31 ft head
Remarks:

H_1 is used when the test length is below the water table
 H_2 is used when the test length is above the water table



Length of Test Section in Feet, L	C _p (Within This Size)			
	2 ft (0.61')	AR (1.07')	3 ft (1.37')	4 ft (1.22')
1	10,000	20,500	25,000	45,500
2	10,000	10,500	16,000	15,500
3	9,000	9,500	9,000	9,500
4	6,000	6,500	6,000	5,500
10	5,700	5,500	5,000	4,500
15	4,000	3,500	3,000	2,500
20	2,500	2,000	1,500	1,000

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SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

UNIFIED SOIL CLASSIFICATION (USCS)												
COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size							
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES			
GRAVELS 50% (+) > 1/4" Ø	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel sand mixtures, little or no fines	Identification Procedures on Fraction Smaller than No. 40 Sieve Size							
		Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel sand mixtures, little or no fines	SILTS AND CLAYS Liquid Limit < 50	DAY STRENGTH (Crushing Characteristics)	DELTANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)				
	GRAVELS WITH FINES (High % Fines)	Non-plastic fines (for identification procedures see ML)	GM	Silty gravels, poorly graded gravel-sand mixtures								
		Plastic fines (for identification procedures see CL)	GC	Clayey gravels, poorly graded gravel-sand mixtures								
SANDS 50% (+) < 1/4" Ø	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	SW	Well graded sand, gravelly sands, little or no fines	SILTS AND CLAYS Liquid Limit > 50	DAY STRENGTH (Crushing Characteristics)	DELTANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)				
		Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines								
	SANDS WITH FINES (High % Fines)	Non-plastic fines (for identification procedures see MC)	SM	Silty sands, poorly graded sand-silt mixtures					HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.		
		Plastic fines (for identification procedures see CL)	SC	Clayey sands, poorly graded sand-clay mixtures								

Boundary classifications: Such possessing characteristics of two groups are designated by combining group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.

All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Dense	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC. COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-3"
Medium Soft	Can be Gouged	Breaks (one blow), crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow), sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows), sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

S-2" O.D. Split-Barrel Sample
 ST-3" O.D. Undisturbed Sample
 O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

X-NX (Conventional) Core (-2-1/8" O.D.)
 Q-NQ (Wireline) Core (-1-7/8" O.D.)
 Z - Other Core Sizes, Specify in Remarks

WATER LEVELS

12/18
 ▼ 12.6" Initial Level w/Date & Depth
 12/18
 ▼ 12.6" Stabilized Level w/Date & Depth

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ATTACHMENT C-6



BORING NO _____

OVERBURDEN MONITORING WELL SHEET

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____

GROUND ELEVATION _____

ELEVATION OF TOP OF SURFACE CASING: _____

ELEVATION OF TOP OF RISER PIPE: _____

STICK - UP TOP OF SURFACE CASING: _____

STICK - UP RISER PIPE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____

TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____

TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: _____

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ATTACHMENT C-7



BORING NO.: _____

CONFINING LAYER MONITORING WELL SHEET

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____

GROUND ELEVATION

CONFINING LAYER

ELEVATION OF TOP OF PERM. CASING: _____

ELEVATION OF TOP OF RISER PIPE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF PERM. CASING: _____

TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____

TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

PERM. CASING I.D. _____

TYPE OF CASING & BACKFILL: _____

ELEVATION / DEPTH TOP CONFINING LAYER: _____

ELEVATION / DEPTH BOTTOM OF CASING: _____

ELEVATION / DEPTH BOT. CONFINING LAYER: _____

ELEVATION / DEPTH TOP OF SEAL: _____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION/DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

TYPE OF SAND PACK: _____

BOREHOLE DIA. BELOW CASING: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____

TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: _____

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ATTACHMENT C-8



BEDROCK MONITORING WELL SHEET OPEN HOLE WELL

BORING NO.: _____

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____

GROUND ELEVATION _____

ELEVATION OF TOP OF CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF CASING: _____

TYPE OF CASING: _____

TEMP. / PERM.: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT: _____

DESCRIBE JOINTS IN BEDROCK AND DEPTH: _____

ELEVATION / DEPTH OF HOLE: _____

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ATTACHMENT C-9



BORING NO.: _____

BEDROCK MONITORING WELL SHEET WELL INSTALLED IN BEDROCK

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____

	ELEVATION OF TOP OF SURFACE CASING : _____
	ELEVATION OF TOP OF RISER PIPE: _____
	ELEVATION TOP OF PERM. CASING: _____
	TYPE OF SURFACE SEAL: _____
	I.D. OF SURFACE CASING: _____
	TYPE OF SURFACE CASING: _____
	RISER PIPE I.D. _____
	TYPE OF RISER PIPE: _____
	BOREHOLE DIAMETER: _____
	PERM. CASING I.D. _____
	TYPE OF CASING & BACKFILL: _____
	ELEVATION / DEPTH TO BEDROCK: _____
	ELEVATION/DEPTH BOTTOM OF CASING: _____
	BOREHOLE DIA. BELOW CASING: _____
	TYPE OF BACKFILL: _____
ELEVATION / DEPTH TOP OF SEAL: _____	
TYPE OF SEAL: _____	
ELEVATION / DEPTH TOP OF SAND PACK: _____	
ELEVATION/DEPTH TOP OF SCREEN: _____	
TYPE OF SCREEN: _____	
TYPE OF SAND PACK: _____	
ELEVATION / DEPTH BOTTOM OF SCREEN: _____	
ELEVATION / DEPTH BOTTOM OF SAND PACK: _____	
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____	
ELEVATION / DEPTH OF HOLE: _____	

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ATTACHMENT C-10



**BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK**

BORING NO. _____

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING _____
ELEVATION _____	DATE _____	METHOD _____
FIELD GEOLOGIST _____		DEVELOPMENT _____
		METHOD _____

The diagram illustrates a vertical well installation. At the top, a casing is shown with a stick-up above ground. Below the ground surface, the casing continues down to a seal. Below the seal is a riser pipe, also sealed at the top. The riser pipe is surrounded by backfill. Below the backfill is another seal. Below this seal is a sand pack, followed by a screen. The screen is surrounded by sand. Below the screen is the bottom of the hole in the bedrock. The diagram includes labels for various components and their elevations/depths.

GROUND ELEVATION _____

ELEVATION OF TOP OF SURFACE CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

DIAMETER OF HOLE: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____

ELEVATION / DEPTH TOP OF BEDROCK: _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: _____

ELEVATION / DEPTH TOP OF SCREEN: _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

CORE / REAM: _____

ELEVATION / DEPTH BOTTOM SCREEN: _____

ELEVATION / DEPTH BOTTOM OF HOLE: _____

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ATTACHMENT D-1

EQUIPMENT CALIBRATION LOG

Instrument (Name/Model Number/Serial Number):

Manufacturer:

Date Purchased:

Calibration Date	Initial Settings	Standard/Gas Used	Procedure	Adjustments Made	Final Settings	Signature	Comments

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ATTACHMENT E

DAILY ACTIVITIES RECORD - FIELD INVESTIGATION

DAILY ACTIVITIES RECORD - FIELD INVESTIGATION	HALLIBURTON NUS
--	------------------------

PROJECT NAME: _____	PROJECT NO.: _____
CLIENT: _____	LOCATION: _____
DATE: _____	ARRIVAL TIME: _____ DEPARTURE TIME: _____
CONTRACTOR: _____	DRILLER: _____
BORING NO.: _____	HNUS REPRESENTATIVE: _____

ITEM(1)	ORIGINAL QUANTITY(2) ESTIMATE	QUANTITY(2) TODAY	PREVIOUS TOTAL(2) QUANTITY	CUMULATIVE QUANTITY(2) TO DATE
1. Mobilization/Demobilization	Job			
2. Overburden Drilling/Sampling, Minimum 6-inch	100 ft.			
3. Overburden Drilling, 10-inch	250 ft.			
4. Overburden Drilling, 14-inch	450 ft.			
5. Bedrock Drilling, 6-inch	530 ft.			
6. Bedrock Drilling, 10-inch	650 ft.			
7. Bedrock Drilling, 14-inch	150 ft.			
8. Temporary 6-inch Steel Casing	250 ft.			
9. Temporary 10-inch Steel Casing	200 ft.			
10. Temporary 14-inch Steel Casing	250 ft.			
11. Permanent 6-inch Steel Casing	1,250 ft.			
12. Permanent 10-inch Steel Casing	400 ft.			
13. PVC Well Construction/Installation	1,120 ft.			
14. Mine Void Sealing	8			
15. Boring Backfilling	NA			
16. Well Development	24 hrs.			
17. Test Borings	200 ft.			
18. Test Pit Excavation	50 hrs.			
19. Standby	20 hrs.			

COMMENTS: _____

- (1) As listed in Specifications
- (2) Include Quantity and Units
(Ex. 20 ft., 6 hrs.)

APPROVED BY:

HALLIBURTON NUS FIELD REPRESENTATIVE

DRILLER OR REPRESENTATIVE

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**ATTACHMENT F
PAGE 1 OF 2
FIELD TRIP SUMMARY REPORT**

SUNDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

MONDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

TUESDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

WEDNESDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

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**ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT**

THURSDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

FRIDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____

SATURDAY

Date: _____ Personnel: _____
Weather: _____ Onsite: _____

Site Activities: _____



HALLIBURTON NUS
Environmental Corporation

**ENVIRONMENTAL
TECHNOLOGIES GROUP**

STANDARD OPERATING PROCEDURES

Number
SA-7.1

Page
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Effective Date
01/02/91

Revision
0

Applicability
ETG

Prepared
Earth Sciences

Approved
D. Senovich

Subject
DECONTAMINATION OF FIELD EQUIPMENT
AND WASTE HANDLING

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1.0 PURPOSE

The purpose of this procedure is to provide reference information regarding the appropriate procedures to be followed when conducting decontamination activities of drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment used during field investigations. This procedure also provides general reference information on the control of contaminated materials.

2.0 SCOPE

This procedure addresses drilling equipment and monitoring well materials decontamination, as well as chemical sampling and field analytical equipment decontamination. This procedure also describes methods of handling contaminated material during field investigations.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Field Operations Leader - Responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with these procedures.

5.0 PROCEDURES

To insure that analytical chemical results are reflective of the actual concentrations present at sampling locations, various drilling equipment and chemical sampling and analytical equipment involved in field investigations must be properly decontaminated. This will minimize the potential for cross-contamination between sampling locations, and the transfer of contamination off site.

5.1 DRILLING EQUIPMENT

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental sample. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.) In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens.

The steam cleaning area shall be designed to contain decontamination wastes and waste waters, and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be provided which is connected to a holding facility. A shallow above-surface tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases, due to budget constraints, such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate

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decontamination area. The location of the steam cleaning area shall be on site in order to minimize potential impacts at certain sites.

Guidance to be used when decontaminating equipment shall include:

- As a general rule, any part of the drilling rig which extends over the borehole, shall be steam cleaned.
- All drilling rods, augers, and any other equipment which will be introduced to the hole shall be steam cleaned.
- The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

5.2 SAMPLING EQUIPMENT

5.2.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points via the use of common bailer, or its attached line, is high unless strict procedures for decontamination are followed. It is preferable, for the aforementioned reason, to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures should be followed.

Before the initial sampling and after each succeeding sampling point, the bailer must be decontaminated. The following steps should be followed if sampling for organic contaminants:

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush may be required if the sample point is heavily contaminated with heavy or extremely viscous compounds
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse
- Acetone or methanol rinse
- Hexane rinse**

* Due to the leaching ability of nitric acid, on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb; or the sampling equipment is dedicated.

** If sampling for pesticides, PCBs, or fuels.

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- Distilled/Deionized water rinse
- Air dry

If sampling for organics only, the nitric acid, acetone, methanol, and hexane rinses may be omitted. Contract-specific requirements may permit alternative procedures.

Braided nylon or polypropylene lines may be used with a bailer, however, the same line must not come in contact with the sample medium, otherwise, the line must be discarded in an approved receptacle and replaced. Prior to use, the bailer should be wrapped in aluminum foil or polyethylene sheeting.

5.2.2 Sampling Pumps

Most sampling pumps are normally low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except the 10 percent nitric acid solution is omitted. Each of the liquid factions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics into the water being sampled (especially the phthalate esters) or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (in order of preference). Whenever possible, dedicated hoses should be used.

5.2.3 Filtering Equipment

Part of the sampling plan may incorporate the filtering of groundwater samples, and subsequent preservation. This should occur as soon after sample retrieval as possible; preferably in the field as soon as the sample is obtained. To this end, three basic filtration systems are most commonly used - the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

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5.3 FIELD ANALYTICAL EQUIPMENT

5.3.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water
- Acetone or methanol rinse
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.2.2 Probes

Probes, e.g., pH or specific ion electrodes, geophysical probes, or thermometers which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, e.g., OVA equipment, the probe will be wiped with clean paper-towels or cloth wetted with alcohol.

5.4 WASTE HANDLING

For the purposes of these procedures, contaminated materials are defined as any byproducts of a field investigation that are suspected or known to be contaminated with hazardous substances. These byproducts include such materials as decontamination solutions, disposable equipment, drilling muds, well-development fluids, and spill-contaminated materials.

The procedures for obtaining permits for investigations of sites containing hazardous substances are not clearly defined at present. In the absence of a clear directive to the contrary by the EPA and the states, it must be assumed that hazardous wastes generated during investigations will require compliance with Federal agency requirements for generation, storage, transportation, or disposal. In addition, there may be state regulations that govern the disposal action. This procedure will exclusively describe the technical methods used to control contaminated materials.

The work plan for a site investigation must include a description of control procedures for contaminated materials. This planning strategy would assess the type of contamination, estimate the amounts that would be produced, describe containment equipment and procedures, and delineate storage or disposal methods. As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils. Handling and disposing of potentially hazardous materials are expensive and dangerous. Until sample analysis is complete, it is assumed that all produced materials suspected of contamination from hazardous chemicals will always require containment.

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5.5 SOURCES OF CONTAMINATED MATERIALS AND CONTAINMENT METHODS

5.5.1 Decontamination Solutions

All decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized rinse solutions such as those recommended for the personnel decontamination station are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. Larger equipment such as backhoes and tractors should be decontaminated in an area provided with an impermeable liner and a liquid collection system. A decontamination area for large equipment could consist of a bermed concrete pad with a floor drain leading to a buried holding tank.

5.5.2 Disposal Equipment

Disposable equipment that could be contaminated during a site investigation typically includes rubber gloves, boots, broken sample containers, and laboratory tissues. These items are small and can easily be contained in 55-gallon drums with lids. These containers should be closed at the end of each work day and upon project completion to provide secure containment.

5.5.3 Drilling Muds and Well-Development Fluids

Drilling muds and well-development fluids are materials used in groundwater monitoring well installations. Their proper use could result in the surface accumulation of contaminated liquids and muds that require containment. Often monitoring wells are placed off the site to determine if hazardous chemicals have migrated below ground. These offsite wells require especially careful management since they threaten contamination of offsite property.

The volumes of drilling muds and well-development fluids used depend on well diameter and depth, groundwater characteristics, and geologic formations. There are no simple mathematical formulas available for accurately predicting these volumes. It is best to rely on the experience of reputable well drillers familiar with local conditions and the well installation techniques selected. These individuals should be able to estimate the sizes of containment structures required. Since guesswork is involved, one should always be prepared to halt drilling or other well-development operations if more containment capacity is needed.

Drilling fluid (mud) is mixed and stored in a container commonly referred to as a mud pit. This mud pit consists of a suction section from which drilling fluid is withdrawn and pumped through hoses and down the drill pipe to the bit and back up the hole to the settling section of the mud pit. In the settling section, the fluid velocity is reduced by a screen and several flow-restriction devices, thereby allowing the well cuttings to settle out of the fluid.

The mud pit may be either portable above-ground tanks commonly made of steel which is preferred or stationary in-ground pits (Attachment A). The above-ground tanks have a major advantage over the in-ground pits because the tanks isolate the natural soils from the contaminated fluids within the drilling system. The tanks are also portable and can usually be cleaned easily.

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As the well is drilled, the sediments that accumulate in the settling section must be removed. This is best done by shoveling them into drums or other similar containers. When the drilling is complete, the contents of the above-ground tank are likewise shoveled or pumped into drums, and the tank is cleaned and available for use.

If in-ground pits are used, they should not extend into the natural water table. They should also be lined with a bentonite-cement mixture followed by a layer of flexible impermeable material such as plastic sheeting. Of course, to maintain its impermeable seal, the material used would have to be nonreactive with the wastes. An advantage of the in-ground pits is that well cuttings do not necessarily have to be removed periodically during drilling because the pit can be made deep enough to contain them. Depending on site conditions, the in-ground pit may have to be totally excavated and refilled with uncontaminated natural soils when the drilling operation is complete.

When the above-ground tank or the in-ground pit is used, a reserve tank or pit should be located at the site as a backup system for leaks, spills, and overflows. In either case, surface drainage should be such that any excess fluid could be controlled within the immediate area of the drill site.

The containment procedure for well-development fluids is similar to that for drilling fluids. The volume and weight of contaminated fluid will be determined by the method of development. When a new well is bailed to produce clear water, substantially less volume and weight of fluid result than when backwashing or high-velocity jetting is used.

5.5.4 Spill-Contaminated Materials

A spill is always possible when a site investigation involves opening and moving containers of liquids. Contaminated sorbents and soils resulting from spills will have to be contained. Small quantities of spill-contaminated materials are usually best contained in drums, while larger quantities can be placed in lined pits or in other impermeable structures. In some cases on-site containment may not be feasible, and immediate transport to an approved disposal site will be required.

5.6 DISPOSAL OF CONTAMINATED MATERIALS

Actual disposal techniques for contaminated materials are the same as those for any hazardous substance--incineration, landfilling, treatment, and so on. The problem centers around the assignment of responsibility for disposal. The responsibility must be determined and agreed upon by all involved parties before the field work starts. If the site owner or manager was involved in activities that precipitated the investigation, it seems reasonable to encourage his acceptance of the disposal obligation. In instances where a responsible party cannot be identified, this responsibility may fall on the public agency or private organization investigating the site.

Another consideration in selecting disposal methods for contaminated materials is whether the disposal can be incorporated into subsequent site cleanup activities. For example, if construction of suitable onsite disposal structure is expected, contaminated materials generated during the investigation should be stored at the site for disposal with other site materials. In this case, the initial containment structures should be evaluated for use as long-term storage structures. Also, other site conditions such as drainage control, security, and soil type must be considered so that proper storage is provided. If onsite storage is expected, then the limited containment structures should be designed for that purpose.

**DECONTAMINATION OF FIELD EQUIPMENT,
AND WASTE HANDLING**

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6.0 REFERENCES

HALLIBURTON NUS Environmental Corporation: Standard Operating Procedure No. 4.33, Control of Contaminated Material.

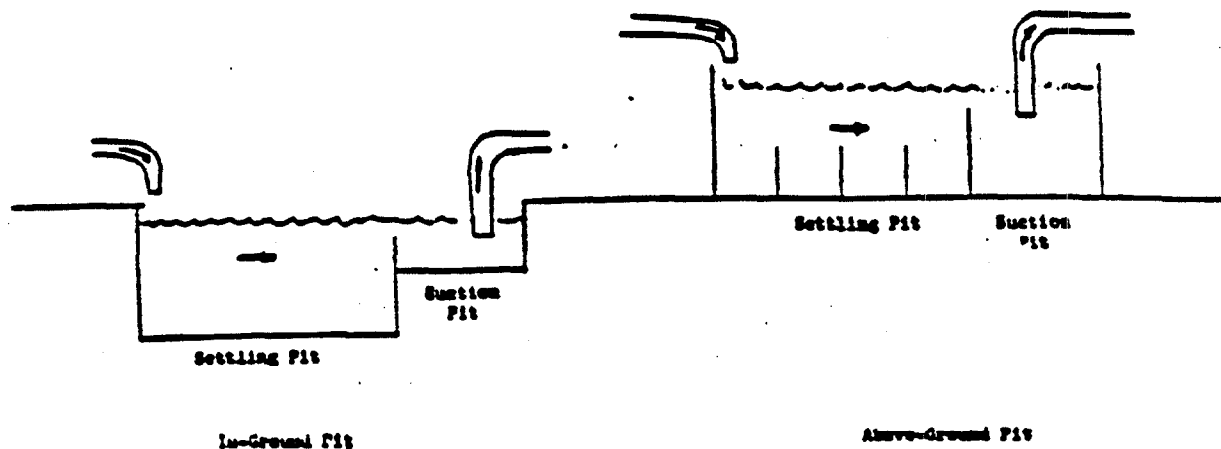
7.0 ATTACHMENTS

Attachment A - Two Types of Mud Pits Used in Drilling.

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FIGURE 5-1

TWO TYPES OF MUD PITS USED IN WELL DRILLING



Source: Ecology and Environment, Inc., Technical Methods for Investigating Sites Containing Hazardous Substances, Draft Technical Monographs, prepared for the U.S. Environmental Protection Agency, June 1981.

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5.0 GUIDELINES

5.1 MEASUREMENT OF pH

5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control, is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken.

Measurements of pH can also be used to check the quality and corrosivity of soil and solid waste samples. However, these samples must be immersed in water prior to analysis, and specific techniques are not described.

Two methods are given for pH measurement: the pH meter and pH indicator paper. The indicator paper is used when only a rough estimate of the pH is required, and the pH meter when a more accurate measurement is needed. The response of a pH meter can be affected to a slight degree by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or basicity of the solution with the indicator compound on the paper. Depending on the indicator and the pH range of interest, a variety of different colors can be used. Typical indicators are weak acids or bases, or both. Process chemistry and molecular transformations leading to the color change are variable and complex.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to hydrogen ion concentration across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to hydrogen ion concentration can be generated and measured.

5.1.3 Equipment

The following equipment is needed for taking pH measurements:

- Accumet 150 portable pH meter, or equivalent.
- Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.
- pH indicator paper, such as Hydrion or Alkacid, to cover the pH range 2 through 12.
- Buffer solutions of pH 4, 7 and 10, or other buffers which bracket the expected pH range.

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5.1.4 Measurement Techniques for Field Determination of pH

1. pH Meter

The following procedure is used for measuring pH with a pH meter (Standardization is according to manufacturers instructions):

- a. The instrument and batteries shall be checked and calibrated prior to initiation of the field effort.
- b. The accuracy of the buffer solutions used for field and laboratory calibration shall be checked. Buffer solutions need to be changed often due to degradation upon exposure to the atmosphere.
- c. Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage. This is not applicable for all electrodes as some must be stored dry.
- d. Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- e. Immerse the electrode(s) in a pH-7 buffer solution.
- f. Adjust the temperature compensator to the proper temperature (on models with automatic temperature adjustment, immerse the temperature probe into the buffer solution). Alternately, the buffer solution may be immersed in the sample and allowed to reach temperature equilibrium before equipment calibration. It is best to maintain buffer solution at or near expected sample temperature before calibration.
- g. Adjust the pH meter to read 7.0.
- h. Remove the electrode(s) from the buffer and rinse well with demineralized water. Immerse the electrode(s) in pH-4 or 10 buffer solution (depending on the expected pH of the sample) and adjust the slope control to read the appropriate pH. For best results, the standardization and slope adjustments shall be repeated at least once.
- i. Immerse the electrode(s) in the unknown solution, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a chemical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.
- j. Read and record the pH of the solution, after adjusting the temperature compensator to the sample temperature. pH shall be recorded to the nearest 0.1 pH unit. Also record the sample temperature.
- k. Rinse the electrode(s) with deionized water.
- l. Keep the electrode(s) immersed in deionized water when not in use.

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The sample used for pH measurement shall never be saved for subsequent conductivity or chemical analysis. All pH electrodes leak small quantities of electrolytes (e.g., sodium or potassium chloride) into the solution. Precipitation of saturated electrolyte solution, especially at colder temperatures, or in cold water, may result in slow electrode response. Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted.

2. pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper.

5.2 MEASUREMENT OF SPECIFIC CONDUCTANCE

5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, while the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not disassociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

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5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

- YSI Model 33 portable conductivity, meter, or equivalent
- Probe for above meter

A variety of conductivity meters are available which may also be used to monitor salinity and temperatures. Probe types and cable lengths vary, so equipment may be obtained to meet the specific requirement of the sampling program.

5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below (standardization is according to manufacturers instructions):

- Check batteries and calibrate instrument before going into the field.
- Calibrate the instrument daily when used. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used. Attachment A may be used for guidance.
- Rinse the cell with one or more portions of the sample to be tested or with deionized water.
- Immerse the electrode in the sample and measure the conductivity. Adjust the temperature setting to the sample temperature.
- Read and record the results in a field logbook or sample log sheet.

If the specific conductance measurements become erratic, or inspection shows that any platinum black has flaked off the electrode, replatinization of the electrode is necessary. See the manufacturer's instructions for details.

Note that specific conductance is occasionally reported at temperatures other than ambient.

5.3 MEASUREMENT OF TEMPERATURE

5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury filled or dial-type thermometers. In addition, various meters such as specific conductance or dissolved oxygen meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

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5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used on a collected water sample:

- Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.
- Record values in a field logbook or sample log sheet.

If a temperature meter or probe is to be used, the instrument shall be calibrated according to manufacturer's recommendations with an approved thermometer before each measurement or group of closely spaced measurements.

5.4 MEASUREMENT OF DISSOLVED OXYGEN CONCENTRATION

5.4.1 General

Dissolved oxygen (DO) levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms as well as the rate of corrosivity, are dependent on the dissolved oxygen concentration. Thus, analysis for dissolved oxygen is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time if the sample is not adequately preserved.

The method monitoring discussed herein is limited to the use of dissolved oxygen meters only. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible, and are free from interference caused by color, turbidity, colloidal material or suspended matter.

5.4.2 Principles of Equipment Operation

Dissolved oxygen probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, but to leave the surface of the solution undisturbed.

Dissolved oxygen probes are relatively free of interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide which are not

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easily depolarized from the indicating electrode. If the gaseous interference is suspected, it shall be noted in the field log book and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer.

5.4.3 Equipment

The following equipment is needed to measure dissolved oxygen concentration:

- YSI Model 56 dissolved oxygen monitor or equivalent.
- Dissolved oxygen/temperature probe for above monitor.
- Sufficient cable to allow the probe to contact the sample.

5.4.4 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure the dissolved oxygen concentration:

- The equipment shall be calibrated and have its batteries checked in the laboratory before going to the field.
- The probe shall be conditioned in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
- The instrument shall be calibrated in the field before each measurement or group of closely spaced measurements by placing the probe in a water sample of known dissolved oxygen concentration (i.e., determined by Winkler method) or in a freshly air-saturated water sample of known temperature. Dissolved oxygen values for air-saturated water can be determined by consulting a table listing oxygen solubilities as a function of temperature and salinity (see Attachment B).
- Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane, either by stirring the sample, or placing the probe in a flowing stream. Probes without stirrers placed in wells can be moved up and down.
- Record the dissolved oxygen content and temperature of the sample in a field logbook or sample log sheet.
- Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This however, may not always be practical. Be sure to record whether the liquid was analyzed in-situ, or if a sample was taken.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen solubilization and positive test interferences.

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5.5 MEASUREMENT OF OXIDATION-REDUCTION POTENTIAL

5.5.1 General

The oxidation-reduction potential (ORP) provides a measure of the tendency of organic or inorganic compounds to exist in an oxidized state. The technique therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of oxidized to reduced species in the sample.

5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and will be dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as dissolved oxygen, may be correlated with ORP to provide a knowledge of the quality of the solution, water, or wastewater.

5.5.3 Equipment

The following equipment is needed for measuring the oxidation-reduction potential of a solution:

- Accumet 150 portable pH meter or equivalent, with a millivolt scale.
- Platinum electrode to fit above pH meter.
- Reference electrode such as a calomel, silver-silver chloride, or equivalent.

5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring oxidation-reduction potential:

- The equipment shall be calibrated and have its batteries checked before going to the field.
- Check that the platinum probe is clean and that the platinum bond or tip is unoxidized. If dirty, polish with emery paper or, if necessary, clean the electrode using aqua regia, nitric acid, or chromic acid, in accordance with manufacturer's instructions.
- Thoroughly rinse the electrode with demineralized water.
- Verify the sensitivity of the electrodes by noting the change in millivolt reading when the pH of the test solution is altered. The ORP will increase when the pH of the test solution decreases and the ORP will decrease if the test solution pH is increased. Place the sample in a clean glass beaker and agitate the sample. Insert the electrodes and note the ORP drops sharply when the caustic is added, the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions. If the ORP does not respond as above when the caustic is added, the electrodes shall be cleaned and the above procedure repeated.
- After the assembly has been checked for sensitivity, wash the electrodes with three changes of water or by means of a flowing stream of water from a wash bottle. Place the sample in a clean glass beaker or sample cup and insert the electrodes. Set temperature

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compensator throughout the measurement period. Read the millivolt potential of the solution, allowing sufficient time for the system to stabilize and reach temperature equilibrium. Measure successive portions of the sample until readings on two successive portions differ by no more than 10 mV. A system that is very slow to stabilize properly will not yield a meaningful ORP. Record all results in a field logbook, including ORP (to nearest 10 mV), sample temperature and pH at the time of measurement.

5.6 SPECIFIC ION ELECTRODE MEASUREMENTS

5.6.1 General

Use of specific ion electrodes can be beneficial in the field for determining the presence and concentration of dissolved inorganic species which may be associated with contaminant plumes or leachate. Thus, electrodes can be used for rapid screening of water quality and determination of water migration pathways.

This procedure provides generic information for specific ion electrodes commonly used in groundwater quality monitoring programs and describes the essential elements of a field investigation program. Analytical methods using some specific ion electrodes have not been approved by the USEPA. In addition, calibration procedures and solutions, interferences and conditions and requirements for use for various electrodes vary greatly. Consequently, review of manufacturer's literature is mandatory prior to use.

5.6.2 Principles of Equipment Operation

All specific ion electrode measurements involve the use of a reference electrode, a pH meter, and a specific ion electrode (SIE). When the SIE and the reference electrode are immersed in a solution of the ion to be measured, a potential difference is developed between the two electrodes. This potential can be measured by a pH meter and related to the concentration of the ion of interest through the use of standard solutions and calibration curves.

Several different types of SIEs are in use: glass, solid-state, liquid-liquid membrane, and gas-sensing. All of the electrodes function using an ion exchange process as the potential determining mechanism. Glass electrodes are used for pH measurement. The glass in the tip of the electrode actually acts as a semi-permeable membrane to allow solution. Solid-state electrodes replace the glass membrane with an ionically-conducting membrane, (but act in essentially the same manner) while liquid-liquid membrane electrodes have an organic liquid ion exchanger contained in the pores of a hydrophobic membrane. Maintenance of the conducting interface, in combination with a reference electrode, allows completion of the electrical circuit and subsequent measurement of the potential difference. Gas-sensing electrodes have a membrane that permits the passage of gas only, thus allowing for the measurement of gas concentration. Regardless of the mechanism involved in the electrode, most SIEs are easy to use under field conditions. The sensitivity and applicable concentration range for various membranes and electrodes will vary.

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5.6.3 Equipment

The following equipment is required for performing quantitative analyses using a specific ion electrode:

- A pH meter with a millivolt scale, or equivalent.
- The specific ion electrode for the parameter to be measured. A partial list of ions which can be measured includes cyanide, sulfide, ammonia, lead, fluoride, and chloride.
- A suitable reference electrode to go with the above SIE.

Specific electrodes for other ions have also been developed, but are not widely used for field investigation efforts at this time. Note that of the specific electrodes referenced above, only fluoride and ammonia have analytical methods approved by the U.S. EPA.

5.6.4 Measurement Techniques for Inorganic Ions Using Specific Ion Electrodes

Different types of electrodes are used in slightly different ways and are applicable for different concentration ranges. Following the manufacturer's instructions, the general steps given below are usually followed:

- Immerse the electrode in water for a suitable period of time prior to sample analysis.
- Standardize the electrode according to the manufacturer's instructions, including necessary chemical additions for ionic strength adjustment, etc. Standard solutions normally differ by factors of ten in concentration. Constant stirring is needed for accurate readings.
- Immerse the electrode in the sample. Allow the reading to stabilize and record the results in a site logbook. Stir the sample at the same rate as the standards. Air bubbles near the membrane shall be avoided, since this may cause interference in millivolt readings.

(NOTE: Each SIE has substances which interfere with proper measurement. These may be eliminated using pretreatment methods as detailed by the manufacturer. It is important to know if interferences are present so that suspect readings may be noted as such.)

- If the pH meter does not read out directly, plot millivolts versus concentration for the standards and then determine sample concentration.

6.0 REFERENCES

American Public Health Association, 1980. Standard Methods for the Examination of Water and Wastewater, 15th Edition, APHA, Washington, D.C.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020.

U.S. Geological Survey, 1984. National Handbook of Recommended Methods for Water Data Acquisition, Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

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1.0 PURPOSE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped offsite for chemical analysis.

2.0 SCOPE

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, while many organic chemicals may dissolve various types of plastic containers. It is therefore critical to select the correct container in order to maintain the quality of the sample prior to analysis.

Many water and soil samples are unstable, and therefore require preservation when the time interval between field collection and laboratory analysis is long enough to produce changes in either the concentration or the physical condition of the constituent(s) requiring analysis. While complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected.

Preservation techniques are usually limited to pH control, chemical addition(s) and refrigeration/freezing. Their purpose is to (1) retard biological activity, (2) retard hydrolysis of chemical compounds/complexes, (3) reduce constituent volatility, and (4) reduce adsorption effects.

3.0 GLOSSARY

HCl - Hydrochloric Acid
H₂SO₄ - Sulfuric Acid
HNO₃ - Nitric Acid
NaOH - Sodium Hydroxide

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing one gram-atom of replaceable hydrogen or its equivalent. Thus, a one molar solution of HCl, containing one gram-atom of H, is "one-normal," while a one molar solution of H₂SO₄ containing two gram-atoms of H, is "two-normal."

4.0 RESPONSIBILITIES

Field Operations Leader - retains overall responsibility for the proper storage and preservation of samples. During the actual collection of samples, the sampling technician(s) will be directly responsible for the bottling, preservation, labeling, and custody of the samples they collect until released to another party for storage or transport to the analytical laboratory.

5.0 PROCEDURES

5.1 SAMPLE CONTAINERS

For most samples and analytical parameters either glass or plastic containers are satisfactory. In general, if the analyte(s) to be determined is organic in nature, the container shall be made of glass. If the analyte(s) is inorganic, then the container shall be plastic. Since container specification will depend on the analyte and sample matrix types (as indicated in Attachment A) duplicate samples shall be taken when both organic and inorganic analyses are required. Containers shall be kept in the

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dark (to minimize biological or photooxidation/photolysis breakdown of constituent) until they reach the analytical laboratory. The sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample is heated during transport (1 liter of water at 4°C expands by 15 ml if heated to 130°F/55°C), however, head space for volatile organic analyses shall be omitted.

For CLP laboratories, containers will be obtained through the CLP Sample Management Office. For Responsible party actions or non-CLP laboratories, the laboratory shall provide containers that have been cleaned according to U.S. EPA procedures. Sufficient lead time shall be allowed. Shipping containers for samples, consisting of sturdy ice chests, are provided by the laboratory of the remedial investigation contractor.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded; because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or missing Teflon liner (if required for the container) shall be discarded.

General sample container and sample volume requirements are listed in Attachment A. Specific container requirements are listed in Attachment B.

5.2 PRESERVATION TECHNIQUES

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the Field or added in the Field. In general, aqueous samples of low concentration organics (or soil samples of low or medium concentration organics) are cooled to 4°C. Medium concentration aqueous samples and high hazard organics sample are not preserved. Low concentration aqueous samples for metals are acidified with HNO₃, while medium concentration and high hazard aqueous metal samples are not preserved. Low or medium concentration soil samples for metals are cooled to 4°C while high hazard samples are not preserved.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

5.2.1 Addition of Acid (H₂SO₄, HCl, or HNO₃) or Base

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade and shall be diluted to the required concentration with double-distilled, deionized water in the laboratory, before Field sampling commences:

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Acid Base	Concentration	Normality	Amount for Acidification*
HCl	1:1 dilution of concentrated HCl	6N	5-10 ml
H ₂ SO ₄	1:1 dilution of concentrated H ₂ SO ₄	18N	2-5 ml
HNO ₃	Undiluted concentrated HNO ₃	16N	2-5 ml
NaOH	400 grams solid NaOH in 870 ml water	10N	2 ml**

* Amount of acid to add (at the specified strength) per liter of water to reduce the sample pH to less than 2, assuming that the water is initially at pH 7, and is poorly buffered and does not contain particulate matter.

** To raise pH of 1 liter of water to 12.

The approximate volumes needed to acidify one liter of neutral water to a pH of less than 2 (or raise the pH to 12) are shown in the last column of the above table. These volumes are only approximate; if the water is more alkaline, contains inorganic or organic buffers, or contains suspended particles, more acid may be required. The final pH must be checked using narrow-range pH paper.

Sample acidification or base addition shall proceed as follows:

- Check initial pH of sample with wide range (0-14) pH paper.
- Fill sample bottle to within 5-10 ml of final desired volume and add about 1/2 of estimated acid or base required, stir gently and check pH with medium range pH paper (pH 0-6 or pH 7.5-14, respectively).
- Add acid or base a few drops at a time while stirring gently. Check for final pH using narrow range (0-2.5 or 11-13, respectively) pH paper; when desired pH is reached, cap sample bottle and seal.

Never dip pH paper into the sample; apply a drop of sample to the pH paper using the stirring rod.

5.2.2 Cyanide Preservation

Pre-sample preservation is required if oxidizing agents such as chlorine are suspected to be present. To test for oxidizing agents, place a drop of the sample on KI-starch paper; a blue color indicates the need for treatment. Add ascorbic acid to the sample, a few crystals at a time, until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 g of ascorbic acid for each liter of sample volume. Add NaOH solution to raise pH to greater than 12 as described in 5.2.1. If oxidizing agents are not suspected, add NaOH as directed.

5.2.3 Sulfide Preservation

Samples for sulfide analysis must be preserved by addition of 4 drops (0.2 ml) of 2N zinc acetate solution per 100 ml sample. The sample pH is then raised to 9 using NaOH. The 2N zinc acetate solution is made by dissolving 220 g of zinc acetate in 870 ml of distilled water to make 1 liter of solution.

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5.2.4 Preservation of Organic Samples Containing Residual Chlorine

Some organic samples containing residual chlorine must be treated to remove this chlorine upon collection (See Attachment A). Test the samples for residual chlorine using EPA methods 330.4 or 330.5 (Field Test Kits are available for this purpose). If residual chlorine is present, add 0.008% sodium thiosulfate (80 mg per liter of sample).

5.2.5 Field Filtration

When the objective is to determine concentration of dissolved inorganic constituents in a water system, the sample must be filtered through a non-metallic 0.45 micron membrane filter immediately after collection. A filtration system is recommended if large quantities of samples must be filtered in the field. The filtration system shall consist of a Büchner funnel inserted into a single-hole rubber stopper, sized to form a seal when inserted into the top of a vacuum filter flask equipped with a single side arm. Heavy-wall Tygon tubing shall be attached to the single side arm of the vacuum filter flask and the suction port of a vacuum pump. The stem of the Büchner funnel shall extend below the level of the side arm of the vacuum filter flask to prevent any solvent from entering the tubing leading to the vacuum pump. Before filtration, the filter paper, which shall be of a size to lay flat on the funnel plate, shall be wetted with the solvent in order to "seal" it to the funnel. Slowly pour the solvent into the funnel and monitor the amount of solvent entering the vacuum filter flask. When the rate of solvent entering the flask is reduced to intermittent dripping and the added aliquot of solvent in the funnel has passed through the filter, the used filter paper shall be replaced with new filter paper. If the solvent contains a high percentage of suspended solids, a coarser-sized nonmetallic membrane filter may be used prior to usage of the 0.45 micron membrane filter. This "prefiltering" step may be necessary to expedite the filtration procedure. Discard the first 20 to 50 ml of filtrate from each sample to rinse the filter and filtration apparatus to minimize the risk of altering the composition of the samples by the filtering operation. For analysis of dissolved metals, the filtrate is collected in a suitable bottle (see Section 5.1) and is immediately acidified to pH 2.0 or less with nitric acid whose purity is consistent with the measurement to be made. Inorganic anionic constituents may be determined using a portion of the filtrate that has not been acidified.

Samples used for determining temperature, dissolved oxygen, Eh, and pH should not be filtered. Do not use vacuum filtering prior to determining carbonate and bicarbonate concentration because it removes dissolved carbon dioxide and exposes the sample to the atmosphere. Pressure filtration can be done using water pressure from the well. If gas pressure is required, use an inert gas such as argon or nitrogen.

Do not filter samples for analysis of volatile organic compounds. If samples are to be filtered for analyzing other dissolved organic constituents, use a glass-fiber or metal-membrane filter and collect the samples in a suitable container (see Section 5.1). Because most organic analyses require extraction of the entire sample, do not discard any of it. After filtering, the membrane containing the suspended fraction can be sealed in a glass container and analyzed separately as soon as practicable. Total recoverable inorganic constituents may be determined using a second, unfiltered sample collected at the same time as the sample for dissolved constituents.

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1.0 PURPOSE

The purpose of these procedures is to provide a general methodology, protocol, and reference information on the proper decontamination procedures to be used on chemical sampling and field analytical equipment.

2.0 SCOPE

This procedure addresses chemical sampling and field analytical equipment only, and should be consulted when equipment decontamination procedures are being developed as part of project-specific plans.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Manager - responsible for ensuring that project-specific plans and the implementation of field investigations are in compliance with these guidelines.

Field Operations Leader - responsible for ensuring that decontamination procedures for all chemical sampling and field analytical equipment are programmed prior to the actual field effort and that personnel required to accomplish the task have been briefed and trained to execute the task.

5.0 PROCEDURES

In order to assure that chemical analysis results are reflective of the actual concentrations present at sampling locations, chemical sampling and field analysis equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e., between sample points) and at the conclusion of the sampling program. This will minimize the potential for cross-contamination between sample points and the transfer of contamination offsite.

This procedure incorporates only those aspects of decontamination not addressed in other procedures. Specifically it incorporates those items involved in decontamination of chemical sampling and field analytical equipment.

5.1 ACCESS FOR SAMPLING

5.1.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points via the use of common bailer, or its attached line, is high unless strict procedures for decontamination are followed. It is preferable, for the aforementioned reason, to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures should be followed.

Subject DECONTAMINATION OF CHEMICAL SAMPLING AND FIELD ANALYTICAL EQUIPMENT	Number SF-2.3	Page 3 of 4
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Before the initial sampling and after each succeeding sampling point, the bailer must be decontaminated. The following steps should be followed if sampling for organic contaminants:

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush may be required if the sample point if heavily contaminated with heavy or extremely viscous compounds
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse
- Acetone or methanol rinse
- Hexane rinse**
- Distilled/Deionized water rinse
- Air dry

If sampling for organics only, the nitric acid, acetone, methanol, and hexane rinses may be omitted. Contract-specific requirements may permit alternative procedures.

Braided nylon or polypropylene lines may be used with a bailer, however, the same line must not come in contact with the sample medium, otherwise, the line must be discarded in an approved receptacle and replaced. Prior to use, the bailer should be wrapped in aluminum foil or polyethylene sheeting.

5.1.2 Sampling Pumps

Most sampling pumps are normally low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except the 10 percent nitric acid solution is omitted. Each of the liquid factions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics into the water being sampled (especially the phthalate esters) or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (in order of preference). Whenever possible, dedicated hoses should be used.

* Due to the leaching ability of nitric acid, on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb; or the sampling equipment is dedicated.

** If sampling for pesticides, PCBs, or fuels.

Subject DECONTAMINATION OF CHEMICAL SAMPLING AND FIELD ANALYTICAL EQUIPMENT	Number SF-2.3	Page 4 of 4
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5.1.3 Filtering Equipment

Part of the sampling plan may incorporate the filtering of groundwater samples, and subsequent preservation. This should occur as soon after sample retrieval as possible; preferably in the field as soon as the sample is obtained. To this end, three basic filtration systems are most commonly used - the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

5.2 FIELD ANALYTICAL EQUIPMENT

5.2.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water
- Acetone or methanol rinse
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.2.2 Probes

Probes, e.g., pH or specific ion electrodes, geophysical probes, or thermometers which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise; in those cases, the methods of decontamination must be clearly described in the FSAP. Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, e.g., OVA equipment, the probe will be wiped with clean paper-towels or cloth wetted with alcohol.

6.0 REFERENCES

None.

7.0 RECORDS

None.

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APPENDIX B

FIELD DOCUMENTATION FORMS

DAILY ACTIVITIES RECORD - FIELD INVESTIGATION

HALLIBURTON NUS

PROJECT NAME: _____ PROJECT NO.: _____
CLIENT: _____ LOCATION: _____
DATE: _____ ARRIVAL TIME: _____ DEPARTURE TIME: _____
CONTRACTOR: _____ DRILLER: _____
BORING NO.: _____ NUS REPRESENTATIVE: _____

ITEM (1)	ORIGINAL QUANTITY (2) ESTIMATE	QUANTITY (2) TODAY	PREVIOUS TOTAL (2) QUANTITY	CUMULATIVE QUANTITY (2) TO DATE

COMMENTS: _____

- (1) AS LISTED IN SPECS
(2) INCLUDE QUANTITY AND UNITS
(Ex. 20 ft., 6 hrs.)

APPROVED BY:

NUS FIELD REPRESENTATIVE_____
DRILLER OR REPRESENTATIVE

TEST PIT LOG	HALLIBURTON NUS
---------------------	------------------------

TEST PIT LOG	HALLIBURTON NUS
---------------------	------------------------

PROJECT: TEST PIT NO.:
PROJECT NO.: DATE:
LOCATION:
FIELD GEOLOGIST:

PROJECT: TEST PIT NO.:
PROJECT NO.: DATE:
LOCATION:
FIELD GEOLOGIST:

PROJECT: TEST PIT NO.:
PROJECT NO.: DATE:
LOCATION:
FIELD GEOLOGIST:

PROJECT: TEST PIT NO.:
PROJECT NO.: DATE:
LOCATION:
FIELD GEOLOGIST:

[illegible]

Test Pit Cross Section and / or Plan View

REMARKS
.....
.....
.....

PHOTO LOG _____

TEST PIT _____

PAGE _____ OF _____

PHOTO LOG _____

TEST PIT _____

PAGE _____ OF _____

PHOTO LOG _____

TEST PIT _____

PAGE _____ OF _____

BORING LOG HALLIBURTON NUS

BORING LOG HALLIBURTON NUS

PROJECT: _____ BORING NO.: _____

PROJECT NO.: _____ DATE: _____ DRILLER: _____

PROJECT NO.: _____ DATE: _____
ELEVATION: _____ FIELD GEOLOGIST: _____

WATER LEVEL DATA: _____

(Date, Time & Conditions) _____

[illegible]

REMARKS _____

BORING _____

PAGE _____ OF _____

* See Legend on back

OVERBURDEN MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING _____
METHOD _____
DEVELOPMENT _____
METHOD _____

	ELEVATION OF TOP OF SURFACE CASING : _____
	ELEVATION OF TOP OF RISER PIPE: _____
	STICK - UP TOP OF SURFACE CASING: _____
	STICK - UP RISER PIPE : _____
	TYPE OF SURFACE SEAL: _____
	I.D. OF SURFACE CASING: _____
	TYPE OF SURFACE CASING: _____
	RISER PIPE I.D. _____
	TYPE OF RISER PIPE: _____
	BOREHOLE DIAMETER: _____
	TYPE OF BACKFILL: _____
	ELEVATION / DEPTH TOP OF SEAL: _____
	TYPE OF SEAL: _____
	DEPTH TOP OF SAND PACK: _____
	ELEVATION / DEPTH TOP OF SCREEN: _____
TYPE OF SCREEN: _____	
SLOT SIZE x LENGTH: _____	
I.D. OF SCREEN: _____	
TYPE OF SAND PACK: _____	
ELEVATION / DEPTH BOTTOM OF SCREEN: _____	
ELEVATION / DEPTH BOTTOM OF SAND PACK: _____	
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____	
ELEVATION / DEPTH OF HOLE: _____	



HALLIBURTON NUS
Environmental Corporation

EQUIPMENT CALIBRATION LOG

Instrument (Name/Model No./Serial No.): _____

Manufacturer _____ **Date Purchased** _____

[illegible]

SAMPLE LOG SHEET



HALLIBURTON NUS
Environmental Corporation

- ☐ Surface Soil
- ☐ Subsurface Soil
- ☐ Sediment
- ☐ Lagoon / Pond
- ☐ Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. _____ Source Location _____

Sample Method:		Composite Sample Data	
		Sample	Time
		Color : Description	
Depth Sampled:			
Sample Date & Time:			
Sampled By:			
Signature(s):			
Type of Sample			
<input type="checkbox"/> Low Concentration			
<input type="checkbox"/> High Concentration			
<input type="checkbox"/> Grab			
<input type="checkbox"/> Composite			
<input type="checkbox"/> Grab - Composite			
		Sample Data	
		Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)
Analysis:	PRESERV :	Observations / Notes	
		Organic	Inorganic
		Traffic Report #	
		Tag #	
		A8 #	
		Date Shipped	
		Time Shipped	
		Laboratory	
		Volume	



SAMPLE LOG SHEET

Page ____ of ____

Case # _____

By _____

- ☐ Spring
☐ Lake
☐ Stream
☐ Other _____

Project Site Name _____ Project Site Number _____

NUS Source No. _____ Source Location _____

Sample Method:		Sample Data			
		pH	S.C.	Temp. (°C)	Color & Turbidity
Depth Sampled:					
Sample Date & Time:					
Sampled By:					
Signatures:					
Type of Sample <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration <input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Grab - Composite					
Analysis:	Preservative				
			Organic	Inorganic	
		Traffic Report #			
		Tag #			
		AB #			
		Date Shipped			
		Time Shipped			
		Lab			
Volume					



HALLIBURTON NUS
Environmental Corporation

SAMPLE LOG SHEET

- ☐ Monitoring Well Data
☐ Domestic Well Data
☐ Other _____

Page _____ of _____

Case # _____

By _____

Project Site Name _____ Project Site Number _____

NUS Source No. _____ Source Location _____

Total Well Depth:		Purge Data				
Well Casing Size & Depth:		Volume	pH	S.C.	Temp. (°C)	Color & Turbidity
Static Water Level:						
One Casing Volume:						
Start Purge (hrs.):						
End Purge (hrs.):						
Total Purge Time (min.):						
Total Amount Purged (gal.):						
Monitor Reading:						
Purge Method:						
Sample Method:						
Depth Sampled:						
Sample Date & Time:		Sample Data				
		pH	S.C.	Temp. (°C)	Color & Turbidity	
Sampled By:						
Signature(s):		Observations / Notes:				
Type of Sample <input type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration <input type="checkbox"/> Grab <input type="checkbox"/> Composite <input type="checkbox"/> Grab - Composite						
Analysis:	Preservative	Organic		Inorganic		
		Traffic Report #				
		Tag #				
		AB #				
		Date Shipped				
		Time Shipped				
		Lab				
		Volume				

HALLIBURTON NUS

[illegible]

• ALL MEASUREMENTS TO NEAREST 0.01 FOOT



Measuring equipment _____

[illegible]

APPENDIX C
DRUM CONTINGENCY PLAN

DRUM CONTINGENCY PLAN

Introduction

Buried drums containing hazardous or nonhazardous materials are not expected to be found at Site 2 - Fire Training Area during the RFI field activities. However, based on unconfirmed reports, the potential exists. In the event that drums are encountered during the test pit activities, this contingency plan has been developed to deal with their handling. Drum handling activities under this plan will be limited to the containerization (overpacking) of a limited number (3 to 5) of drums. If additional drums are encountered, a revised drum handling plan will be required. During the RFI field activities, a geophysical survey will be conducted. If this survey indicates that extensive buried metal objects are present, then this plan will be revised to address extensive drum removal actions.

The type of drums encountered may consist of plastic or metal 55-gallon containers. The potential conditions of buried drums include the following.

- Crushed/empty
- Intact/empty
- Intact/full/good condition
- Intact/full/poor condition
- Breached/partially full

Based on contamination found at this Site during the SI, as well as current and historic activities at the NWIRP, hazardous materials which may be encountered in buried drums are as follows.

- Chlorinated organic solvents
- Non-chlorinated organic solvents
- Hydrocarbon fuels
- Oils
- PCBs
- Toxic metals

Contingency Equipment

The following equipment/supplies will be maintained at the site for use in the removal and overpacking of a limited number of drums.

- Drum sling (for attachment to the backhoe).
- Plastic sheeting for construction of a secondary containment pad and cover.
- Three overpacks with appropriate adsorbent.
- Adsorbents

Drum Removal

The only drums which are currently considered for removal during the RFI activities are those that present a potential imminent risk to the environment and/or human health and that can be safely excavated during the field work. This includes buried drums that are full and in relatively good condition and drums that are breached and partially full, but are structurally sound. A decision regarding the ability to safely extract the drum will be made in the field to minimize the potential of increasing the environmental impact. If drums are encountered, the EPA and NYSDEC will be notified within 24 hours.

A preliminary determination as to the presence and location of drums will be made based on the results of the geophysical survey. A backhoe will be used to aid in the uncovering of a suspected drum. When in the vicinity of a suspected drum, slow and careful soil penetration (not exceeding 4 inches per scoop) will be made with the backhoe bucket. When the presence of a drum is evident or if digging resistance, which may be caused by a drum, is encountered, manual digging using a shovel will be used to uncover the drum. Once the drum is uncovered, the overall condition of the drum will be evaluated. If the drum is to be removed, an overpac drum will be placed in the excavation adjacent to the drum to minimize movement of the buried drum. A drum sling will be placed around the drum and the drum will be lifted using the backhoe and placed into the overpac. The overpac containing the drum will be lifted and placed in a secondary containment pad, which will be constructed near the equipment decontamination pad.

Health and Safety

Health and safety issues are addressed in the HASP. If buried drums are to be excavated, the Health and Safety Officer and Project Manager will be notified prior to initiating any activities. In addition, Grumman Spill Response and Fire Personnel will be notified.

**RCRA Facility Investigation
Project Management Plan
for
Naval Weapons
Industrial Reserve Plant
Calverton, New York**



**Northern Division
Naval Facilities Engineering Command
Contract Number N62472-90-D-1298
Contract Task Order 0090**

July 1993

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1.0 PROJECT MANAGEMENT ORGANIZATION AND APPROACH

The overall project management organization for the RCRA Facility Investigation (RFI) at the Naval Weapons Industrial Reserve Plant (NWIRP) in Calverton, Long Island, New York is shown in Figure 1-1. The project will be directed by Ms. Debra Felton, P.E., Remedial Project Manager (RPM), Navy - Northern Division. Mr. Martin Simonson, DPRO - NWIRP Calverton will be the local point of contact at the activity. The Navy RPM is responsible for the overall management of the IR Program for the NWIRP Calverton.

1.1 HALLIBURTON NUS PERSONNEL

Mr. David Brayack, P.E. will serve as the Project Manager for Halliburton NUS. The Project Manager is responsible for the day-to-day contact with the Navy's RPM, and for maintaining the projects scope, schedule, and budget. Supporting the Project Manager are the following key personnel: Mr. Mark Mengel, Field Operations Leader; and Mr. J.P. Pradeep, Project Engineer. The qualifications of these key personnel are listed below.

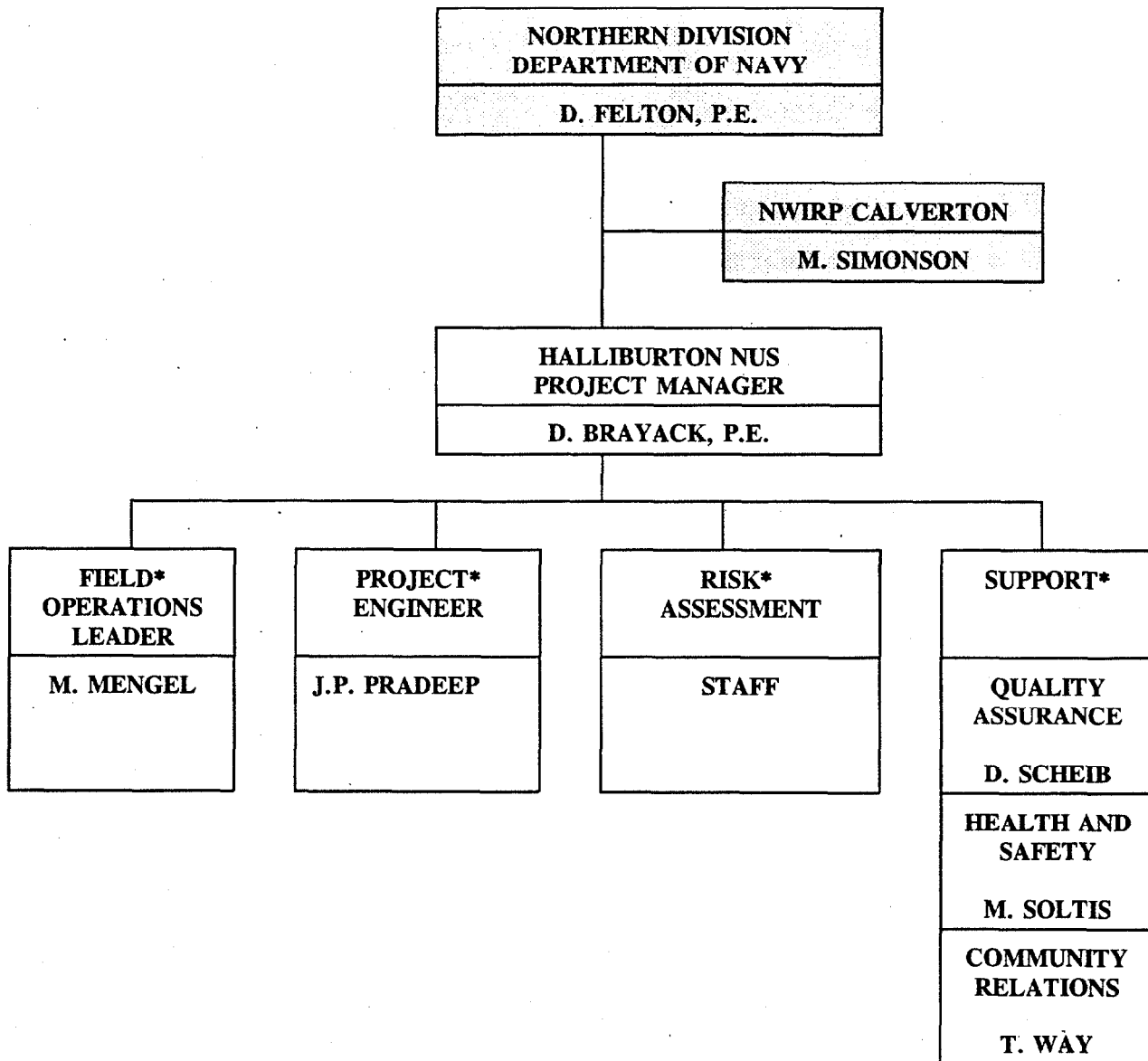
Mr. Brayack, P.E. has served as Project Manager on numerous sites. On industrial and government projects he has participated on as Project Manager, Project Engineer, and/or Process Engineer include site investigations, remedial investigations, feasibility studies, treatability studies, process design and so on. Mr. Brayack has participated in past efforts at the NWIRP Calverton.

Mr. Mengel will be responsible for the coordination of all field activities as well as evaluating the results of the geologic/hydrogeologic investigation. Mr. Mengel has been a FOL on several sites. His work experience includes soil-gas and geophysical surveys, layout and installation of monitoring wells, drilling supervision, borehole logging, multi-media sampling, aquifer testing, and so on. Mr. Mengel has conducted previous work on a RFI/CMS for the Navy.

Mr. Pradeep holds a Masters Degree in Chemical Engineering. He has participated in several feasibility studies dealing with soils and groundwater remediation. Mr. Pradeep has also participated in several wastewater treatment system design projects. He has participated in past efforts at the NWIRP Calverton.

FIGURE 1-1

**PROJECT TEAM ORGANIZATION
NWIRP CALVERTON, LONG ISLAND, NEW YORK**



Government Representatives

* Additional personnel are available on an as-needed basis.

Ms. Debra Scheib, Quality Assurance; Mr. Matt Soltis, Health and Safety; and Ms. Tammy Way, Community Relations, will provide support to this project, as necessary. Also, additional personnel are available on an as-needed basis.

Field work will be performed under the direction of the Field Operations Leader (FOL). The FOL will be responsible for coordinating and overseeing all field activities and will interface with the Health and Safety Site Officer (HSSO) in planning and performing the RFI tasks. In accordance with the Health and Safety Plan, the HSSO or his designee will interact with the field team members during performance of their tasks. The specific responsibilities of the FOL and the HSSO are discussed below.

- Field Operations Leader (FOL) - The FOL is responsible for all day-to-day aspects of the RFI field work. The responsibilities of the FOL include the following.
 - Assuring that all field team members are familiar with the project Work Plan.
 - Assuring that all field team members have completed health and safety training.
 - Coordinating the activities of all field teams.
 - Reporting to the Project Manager on a regular basis regarding the status of all field work and any problems encountered.
 - Completing Task Modification Requests, as necessary, for approval by the Project Manager.
 - Providing field team members with daily assignments.
 - Assuring that field team members comply with the procedures outlined in the Work Plan.
 - Coordinating field activities to ensure sample shipping schedules are met.
- Health and Safety Site Officer (HSSO) - The HSSO reports to the Halliburton NUS Manager of Health and Safety and indirectly to the FOL and Project Manager. Details of the HSSO's responsibilities are presented in the HASP and include the following.
 - Controlling specific health and safety related field operations such as personnel decontamination, monitoring of worker heat or cold stress, distribution of safety equipment, etc.
 - Assuring that field team personnel comply with all procedures established by the HASP.
 - Identifying assistant HSSOs or HSSO designees.
 - Terminating work if an imminent safety hazard, emergency situation, or other potentially dangerous situation is encountered.

1.2 HALLIBURTON NUS PERSONNEL TRAINING

Halliburton NUS personnel qualifications were briefly addressed in Section 1.1. All personnel receive a variety of technical and administrative training. These may include attending project management training, technical writing courses, quality improvement process awareness sessions, quality education process training, sessions or seminars in specific technical areas (i.e., treatment processes, karst geology, HRS scoring, RCRA, and so on) and, of course, health and safety training. The balance of this section focuses on Halliburton NUS' health and safety program.

As required under OSHA Standard 29 CFR 1910.120, Halliburton NUS employees and their subcontractors are required to obtain the appropriate level of training prior to working at CERCLA or at certain RCRA sites. Halliburton NUS personnel will be trained in accordance with Halliburton NUS' Health and Safety Standard Operational Procedures (HSSOPs). Subcontractors must provide documentation of their compliance with 1910.120.

1.2.1 Specific 29 CFR 1910.120 Training

The level of training that is required is specified in the HSSOPs and is dependent upon the level of involvement in site work. The level of training required, as specified in the HSSOPs, that must be completed is listed below:

- 40-hour "initial training" with an additional minimum of 3 days actual field experience, for general site workers.
- 24-hour "initial training" for occasional site workers with an additional minimum of 1 day of actual field experience. Occasional site workers are workers responsible for performing a specified limited task who will not be exposed over permissible exposure limits and published exposure limits, or be required to wear respiratory protection.
- 24-hour "initial training" with an additional minimum of 1 day of actual field experience is required for workers regularly on site but who work in areas monitored and fully characterized. Such characterization must indicate that exposures are under permissible exposure limits and published exposure limits, that respirators are not necessary, and that there are no health hazards or the possibility of an emergency developing.
- 8-hour management and supervisor training.

- 8-hour refresher training, required on an annual basis after the initial 40-hour or 24-hour trainings, listed above.
- Each of the field training requirements specified above requires that the training be conducted under the direct supervision of a trained, experienced supervisor.

1.2.2 Training Content

The content of each training program must comply with 29 CFR 1910.120 paragraph (e) (2) and Halliburton NUS' HSSOPs. The content of the 40-hour, the two 24-hour, and the 8-hour refresher courses as conducted by Halliburton NUS are as follows:

- Review of 29 CFR 1910.120
- Toxicology
- Chemical and Physical Hazards
- Respiratory Protection
- Personal Protective Equipment
- Decontamination
- Monitoring Instrumentation
- Site Operations
- Field Exercises
- Written Examination

The content of the 8-hour Halliburton NUS management and supervisory courses follow the requirements of 29 CFR 1910.120. On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations must receive 40-hours initial training, 3 days field experience, and at least 8 additional hours of specialized training at the time of job assignment. Training must include topics as, but not limited to, the employer's health and safety program and the associated training program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques.

1.2.3 Records Maintenance

As stated above all Halliburton NUS employees are required to successfully complete the required health and safety training. Halliburton NUS maintains documentation in a Health and Safety Data Base maintained by the Health Sciences Department in Pittsburgh, Pennsylvania. The training date for the initial training, refresher training, and management/supervisory trained are all recorded in the Data Base. Written documentation is also provided to those

Halliburton NUS personnel who successfully complete the training. Halliburton NUS personnel also participate in a medical monitoring program. Baseline and annual physicals are required and results are evaluated and maintained by a qualified physician.

1.2.4 Site-Specific Training

As well as the training required above, Halliburton NUS requires site-specific training for all Halliburton NUS personnel and their subcontractors before they can initiate any site work. The content of the site-specific training is based upon the same information as described above except it addresses information specific to the site and task for the job being performed. The number of hours for the site-specific training is dependent on the site, the task performed, and the role of the individual performing the specific task. Documentation of site-specific training must be maintained in the permanent site log book.

2.0 OBJECTIVES AND TECHNICAL APPROACH

This section provides a brief discussion regarding the overall objectives and technical approach for performing RFI activities.

2.1 OBJECTIVES

This RFI Work Plan addresses the following sites:

- Site 1 - Northeast Pond Disposal Area
- Site 2 - Fire Training Area
- Site 6A - Fuel Calibration Area
- Site 7 - Fuel Depot Area

The overall objective of the RFI is to determine the nature and extent of contamination.

2.2 TECHNICAL APPROACH

Field work at four sites is addressed in this Work Plan. Subsequent to receiving a Notice to Proceed from the Navy, Procurement of Subcontractors and Field Work will be initiated.

Field work at the sites may consist of soil-gas surveys, geophysical survey, test pits, subsurface soil borings, temporary wells/field-based groundwater sampling and analysis, monitoring well drilling and installation, or sampling of soil, sediment, surface water, or groundwater. Soil-gas surveys will be used to delineate the extent of soil-gas contamination and to aid in the selection of locations for temporary well placement. Geophysical surveys will be used to locate buried metal objects and may be used to refine test pit and subsurface soil boring activities. Test pits will be used to delineate the extent of fill material. Soil borings and monitoring well installation will be used to determine geological and hydrogeologic conditions. Along with the various media sampling, test pits will also be used to determine the nature and extent of contamination. Specific field activities for each site are presented in Table 2-1. General and site-specific field activities are detailed in Plan A, Data Collection Quality Assurance Plan.

TABLE 2-1

**SUMMARY OF SITE-SPECIFIC FIELD ACTIVITIES FOR RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Activity	Site 1 - Northeast Pond Disposal Area	Site 2 - Fire Training Area	Site 6A - Fuel Calibration Area	Site 7 - Fuel Depot Area
Soil Gas Survey		X	X	X
Geophysical Survey		X		
Test Pit Excavation	X	X		
Subsurface Soil Borings	X	X	X	X
Temporary Wells/Field-based groundwater sampling and analysis		X	X	X
Monitoring Well Drilling and Installation	X	X	X	X
Surface Soil Sampling	X	X	X	
Surface Water/Sediment Sampling	X			
Waste Sampling	X	X		
Monitoring Well/Groundwater Sampling	X	X	X	X
Staff Gauges	X			
Water Level Measurement	X	X	X	X
Site Survey	X	X	X	X
Aquifer Testing	X	X	X	X

Samples collected during field activities will either be analyzed on site or sent to a laboratory for analysis. Analytical results and other data collected during field activities will be included in the RFI report. A Rough Draft RFI report will be prepared for internal Navy review. Navy comments will then be addressed and a Draft RFI report will be prepared for external State/TRC review. A Final RFI report will be prepared after comments on the Draft RFI are received.

2.3 WORK PLAN ORGANIZATION

This Work Plan is comprised of five separate plans, as required by the Scope of Work included in the RCRA Permit. This plan is the Project Management Plan (Plan B). Additional required plans include the Data Collection Quality Assurance Plan (Plan A), the Data Management Plan (Plan C), the Health and Safety Plan (Plan D), and the Community Relations Plan (Plan E).

3.0 SCHEDULE

A preliminary schedule for implementing work at the NWIRP in Calverton is presented below. The schedule is based on the number of weeks required for each activity and Week 1 begins after receiving a notice to proceed from the Navy.

Activity	Preliminary Schedule
Notice to Proceed from Navy	Start of Week 0
Mobilization	Weeks 1 to 8
Field work	Weeks 8 to 20
Laboratory Data Analysis	Weeks 20 to 25
Data evaluation; prepare rough draft RFI for Navy review	Weeks 25 to 32
Address comments; prepare draft RFI for State/TRC review	Weeks 32 to 36
Address comments; prepare final RFI	Weeks 36 to 44

**RCRA Facility Investigation
Data Management Plan**
for
**Naval Weapons
Industrial Reserve Plant**
Calverton, New York



**Northern Division
Naval Facilities Engineering Command**
Contract Number N62472-90-D-1298
Contract Task Order 0090

July 1993

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1.0 INTRODUCTION

Documentation and record-keeping procedures are important for maintaining control of data generated from site characterization and sampling activities. Precautions will be taken in the analysis and storage of the data collected to prevent the introduction of errors or the loss or misinterpretation of data. This Data Management Plan outlines the procedures that will be implemented to document and track the data and results generated by this investigation.

1.1 ORGANIZATION

Halliburton NUS has overall responsibility for the management and direction of the RCRA Facility Investigation (RFI), including field investigations and report preparation. Project files containing data and reports generated during the RFI will be maintained at Halliburton NUS' Pittsburgh, Pennsylvania office according to the procedures outlined in this document.

All laboratory documentation will be filed at the Halliburton NUS' Pittsburgh office. Laboratory documentation (chromatograms and results of spike samples) will be maintained for purposes of validating analytical data collected during the RFI. All summary reports will be kept in the Halliburton NUS central project file in Pittsburgh.

2.0 DATA TRACKING AND RECORDING

2.1 DATA DOCUMENTATION AND TRANSFER

All incoming data and reports will be logged and dated. All information generated from field activities will be documented on the appropriate Halliburton NUS forms including the following:

- Sample/Core Log
- Water Sampling Log
- Chain-of-Custody Record
- Daily Log
- Drilling and Installation of Monitoring Wells Daily Checklist
- Utilities and Structures Checklist
- Location Sketch
- Water Level/Pumping Test Record
- Materials/Cost Log
- Sample Container Inventory
- Well Construction Log
- Sampling of Monitoring Wells Daily Checklist
- Telephone Conversation Log

These documents will include, as appropriate, the following information.

- Unique sample identification number
- Laboratory analysis identification number
- List of analyte parameters
- Sampling or field measurement location
- Sample or measurement type

Incoming documents will be date-stamped and filed in the central project file as are the site log books and any other pertinent information collected or generated in the field. If distribution is required, the appropriate number of copies will be made and distributed to project personnel. In addition, all notes from project meetings and telephone conversations will be filed along with other project documents.

The field operations guidelines that require the use of site log books, log sheets, etc., are discussed in the Data Collection Quality Assurance Plan (Plan A) of this report.

2.2 DATA TRACKING

A tracking system will be used to maintain an up-to-date status of the location of the analytical data within the system. This manual tracking system will be implemented as soon as samples obtained in the field are sent to the laboratory for analyses. Major milestones noted will be: date that samples are shipped to the laboratory; date that raw data is received from the laboratory; and date that the package has been reviewed for completeness and quality. As part of this review the laboratory analysis identification numbers will be correlated with the sample identification numbers, with both listed on the sample log sheets. If a package is incomplete, a request will be made of the laboratory to submit the missing information. The project manager may also use this tracking system to identify any delays in receiving data from the laboratory.

Once the data packages have been reviewed for completeness and quality, the data will be entered into a computer database. DBase 3 or similar software is typically used and tailored to site-specific needs. Standard information entered into the database includes:

- Site name
- Media
- Sample identification number
- Description
- Units
- Date sampled
- Compound analyzed
- Concentration

The data entered is checked for accuracy against the raw data package to prevent errors. The raw data is then placed in the central project file for future reference as necessary.

2.3 DATA REDUCTION AND COMPUTER STORAGE

The reduction of field and analytical data will consist of summarizing water-level measurements, soil boring logs, well construction and sampling logs, field parameters, and laboratory analytical results. These data will be

presented in the form of tables, illustrations, and/or graphs. The original data and reduction forms will be maintained at Halliburton NUS' Pittsburgh office until acceptance of final reports.

Chemical and physical data will be stored and managed using a data-management computer system. Data entry will be performed by a designated person, so access to the data base is limited. Replicate measurements of a single sample will be averaged prior to further data reduction for data summary tables. Any tables or graphs generated will include the following:

- Sample identification
- Sample location
- Laboratory identification
- Sample matrix
- Analyses performed
- Date sampling occurred
- Detection limits
- Analytical results
- Quality control results
- Relevant notes regarding analyses

3.0 TABULAR DISPLAYS AND GRAPHICAL DATA

3.1 TABULAR DISPLAYS

Both laboratory results and pertinent field measurements will be presented in tabular displays. The computer database will be used to sort the data by medium. A typical tabular display is presented in Figure 3-1. When necessary, sorting can be conducted for specific sample numbers. Such capabilities are useful for displaying data by stratification factors, such as location, soil layer, or topography. The database can be programmed to print out a list of sample numbers and concentrations by constituent, if required. In any case, such information could easily be manually pulled from the database and presented in a tabular format.

Computer-generated statistical analyses are also available. A typical tabular display is presented in Figure 3-2. As appropriate, parameters such as numbers of positive detections, minimum detected concentration, maximum detected concentration, and average can be calculated.

Field measurements that were documented on the sample log sheets are manually transferred to tables for display, if necessary.

3.2 GRAPHICAL DATA

Several methods of graphically presenting data are used for reporting. As a minimum, figures are prepared to illustrate sampling location, the sampling grid, and the boundaries of the study area. These can be used in conjunction with the tabular display of data to provide the necessary site characterization data.

As appropriate, additional graphics can be prepared. These include:

- Displaying levels of contamination at each sampling location.
- Illustration changes in concentration in relation to distance from the source, time, depth, or other parameters.
- Indicating features affecting intra-media transport and showing potential receptors.

These additional graphical displays can be prepared if the quantity of data generated is suitable to provide such information.

FIGURE 3-1

**SITE XYZ - SOIL BORINGS
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

SAMPLE NUMBER:
X MOISTURE/SOLIDS:
DILUTION FACTOR:
DESCRIPTION:
UNITS:
DATE SAMPLED:

KE-SB01-0002	KE-SB01-0002DL	KE-SB01-0406	KE-SB01-0406DL	KE-SB01-0708	KE-SB01-0708DL	KE-SB02-0002-3B
14	13	8	9	10	9	
2	10	10		10		NO VOA'S
MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	MEDIUM	
UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	UG/KG	
09/25/88	09/25/88	09/25/88	09/25/88	09/25/88	09/25/88	10/09/88

*** VOLATILES ***

PP	CAS NO	COMPOUND					
	67-64-1	ACETONE					
	78-93-3	2-BUTANONE			810J		
	591-78-6	2-HEXANONE					
	108-10-1	4-METHYL-2-PENTANONE					
4V	71-43-2	BENZENE					
8GV	108-88-3	TOLUENE	20000	16000	24000		
3HV	100-41-4	ETHYLBENZENE		1400J	1400J		
	95-47-6	TOTAL XYLENES		8200	8600		
7V	108-90-7	CHLOROBENZENE		1300J	2400J		
11V	71-55-6	1,1,1-TRICHLOROETHANE	37000J	32000J	58000J	38000J	
14V	79-00-5	1,1,2-TRICHLOROETHANE					
10V	75-34-3	1,1-DICHLOROETHANE					
10V	107-06-2	1,2-DICHLOROETHANE					
85V	127-18-4	TETRACHLOROETHENE	22000	18000J	70000		
87V	79-01-6	TRICHLOROETHENE	130000	100000			
30V	156-60-5	TOTAL-1,2-DICHLOROETHENE	22000	18000	35000	23000	
29V	75-35-4	1,1-DICHLOROETHENE					
88V	75-01-4	VINYL CHLORIDE					
23V	67-66-3	CHLOROFORM					
11V	75-09-2	METHYLENE CHLORIDE					
	75-15-0	CARBON DISULFIDE					

*** BASE/NEUTRALS ***

PP	CAS NO	COMPOUND					
66B	117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	51000	42000	34000	33000	27000 75000

FIGURE 3-2

SITE XYZ
STATISTICAL ANALYSIS FOR SAMPLE TYPE
NWIRP CALVERTON, LONG ISLAND, NEW YORK

PP NO	CAS NO	COMPOUND	# OF POSITIVE DETECTIONS	MINIMUM DETECTED CONC.	MAXIMUM DETECTED CONC.	AVERAGE
	67-64-1	ACETONE	9	44.0000	510.0000	18.0849
	78-93-3	2-BUTANONE	17	1.0000	810.0000	52.2358
	591-78-6	2-HEXANONE	1	410.0000	410.0000	5.8679
	108-10-1	4-METHYL-2-PENTANONE	7	19.0000	3400.0000	77.8762
4V	71-43-2	BENZENE	9	7000	730.0000	21.8840
24V	108-88-3	TOLUENE	23	8000	150000.0000	5034.2528
32V	100-41-4	ETHYLBENZENE	29	2.0000	15000.0000	651.8868
	75-47-6	TOTAL XYLENES	29	10.0000	75000.0000	3605.6509
7V	108-90-7	CHLOROBENZENE	24	12.0000	15000.0000	514.6781
11V	71-55-6	1,1,1-TRICHLOROETHANE	25	7000	810000.0000	14294.5924
14V	79-00-5	1,1,2-TRICHLOROETHANE	1	130.0000	130.0000	1.7264
10V	75-34-3	1,1-DICHLOROETHANE	10	32.0000	4200.0000	110.5019
10V	107-06-2	1,2-DICHLOROETHANE	3	48.0000	2500.0000	58.1827
15V	127-18-4	TETRACHLOROETHENE	32	3000	470000.0000	23906.3703
87V	79-01-6	TRICHLOROETHENE	18	3000	1200000.0000	37387.9406
20V	156-60-5	TOTAL-1,2-DICHLOROETHENE	28	5.0000	110000.0000	5595.7075
29V	75-35-4	1,1-DICHLOROETHENE	4	4.0000	480.0000	6.0566
80V	75-01-4	VINYL CHLORIDE	2	260.0000	15000.0000	143.7623
23V	67-66-3	CHLOROFORM	2	420.0000	920.0000	12.6415
44V	75-09-2	METHYLENE CHLORIDE	3	8.0000	940.0000	9.0377
	75-15-0	CARBON DISULFIDE	1	8000	8000	0.0075
660	117-81-7	BIS(2-ETHYLHEXYL)PHTHALATE	54	10.0000	200000.0000	30564.6415
690	117-84-0	D1-N-OCTYL PHTHALATE	3	29.0000	110.0000	1.8962
680	84-74-2	D1-N-BUTYL PHTHALATE	31	32.0000	2100.0000	69.2736
700	84-64-2	D1ETHYL PHTHALATE	1	22.0000	22.0000	2075
720	56-55-3	BENZ(a)ANTHRACENE	2	49.0000	73.0000	1.1509
740	205-99-2	BENZ(a)FLUORANTHENE	2	76.0000	92.0000	1.5849
730	50-32-8	BENZ(a)PYRENE	2	24.0000	48.0000	6.792
760	210-01-9	CHRYSENE	2	31.0000	77.0000	1.0189
390	206-44-0	FLUORANTHENE	19	26.0000	12000.0000	313.1415
800	86-73-7	FLUORENE	5	68.0000	1200.0000	14.4245
550	91-20-3	NAPHTHALENE	41	17.0000	23000.0000	1985.6152
	91-57-6	2-METHYLNAPHTHALENE	33	370.0000	24000.0000	2103.8679
110	85-01-8	PHENANTHRENE	15	28.0000	2400.0000	76.8679
840	129-00-0	PYRENE	8	11.0000	110.0000	3.5943
	75-50-1	1,2-DICHLOROBENZENE	40	47.0000	150000.0000	107100.3471
240	541-73-1	1,3-DICHLOROBENZENE	30	160.0000	88000.0000	5647.7358
270	106-46-7	1,4-DICHLOROBENZENE	40	170.0000	290000.0000	19908.3019
88	120-82-1	1,2,4-TRICHLOROBENZENE	29	210.0000	51000.0000	2489.2453
	132-64-9	DIBENZOFURAN	1	1200.0000	1200.0000	11.3208
45A	108-95-2	PHENOL	11	580.0000	75000.0000	2620.5660
	95-48-7	2-METHYLPHENOL	9	60.0000	25000.0000	757.5472
	106-44-5	4-METHYLPHENOL	9	210.0000	45000.0000	982.2642
54A	105-67-9	2,4-DIMETHYLPHENOL	10	110.0000	16000.0000	364.5849
92P	50-27-3	4,4'-DDB	1	19.0000	19.0000	1.192
107P	11097-69-1	ARCCLOX 1254	11	200.0000	6500.0000	275.6604
111P	11076-82-5	ARCCLOX 1260	2	240.0000	320.0000	5.2830
2		ANTIMONY	14	6200	5.0000	1541
3		ARSENIC	87	8900	12.0000	2.7095

RCRA Facility Investigation Health and Safety Plan

for

Naval Weapons Industrial Reserve Plant

Calverton, New York



**Northern Division
Naval Facilities Engineering Command**

Contract Number N62472-90-D-1298

Contract Task Order 0090

July 1993

**HEALTH AND SAFETY PLAN
RCRA FACILITY INVESTIGATION
FOR
NAVAL WEAPONS INDUSTRIAL RESERVE PLANT
CALVERTON, NEW YORK**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT**

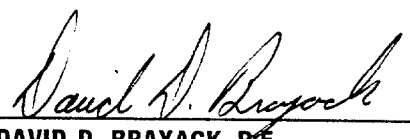
**Submitted to:
Northern Division
Environmental Branch, Code 18
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090**

**Submitted by:
HALLIBURTON NUS Corporation
993 Old Eagle School Road, Suite 415
Wayne, Pennsylvania 19087-1710**

**Contract Number N62472-90-D-1298
Contract Task Order 0090**

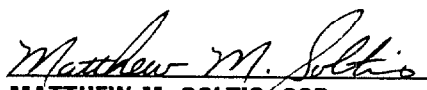
JULY 1993

SUBMITTED BY:



**DAVID D. BRAYACK, P.E.
PROJECT MANAGER
HALLIBURTON NUS CORPORATION
PITTSBURGH, PENNSYLVANIA**

APPROVED BY:



**MATTHEW M. SOLTIS, CSP
CLEAN HEALTH AND SAFETY MANAGER
HALLIBURTON NUS CORPORATION
PITTSBURGH, PENNSYLVANIA**

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1.0 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: NWIRP Calverton
Address: Suffolk County, New York

Client Contact: Debra Felton
Phone Number: (215) 595-0567
Other Contacts: Martin Simonson
Phone Number: (516) 575-9952

Effective Date: 12/02/92
Purpose of Site Visit: Remedial Investigation
Proposed Dates of Work: Periodically 10/93 through 08/94

Project Team:

HALLIBURTON NUS Personnel:

David Bravack
Mark Mengel
To Be Determined

Discipline/Tasks Assigned:

Project Manager
Field Operations Leader (FOL)
Site Safety Officer (SSO)

Non-HALLIBURTON NUS Personnel/Affiliation

Plan Preparation:

Prepared by: Thomas M. Dickson (1/1/93)

Reviewed and Approved by: Matthew M. Felt (7/8/93)

Reviewed:

HALLIBURTON NUS
Project Manager: David J. Bravack (2/8/93)

Follow Up Report:

Responsible Person: Mark Mengel
(Must fill out Follow-up Report)

1.1

INTRODUCTION

This Health and Safety Plan (HASP) has been developed to provide the minimum safety and health practices and procedures for Halliburton NUS Corporation employees and Halliburton NUS subcontractor personnel engaged in Remedial Investigation activities at the NWIRP Calverton facility. This plan was developed using available information regarding known/suspected chemical contaminants and physical hazards that may be encountered during the planned investigatory activities. If additional information becomes available prior to or throughout the course of field activities, this document will be modified accordingly. Modifications will be determined by the Halliburton NUS Site Safety Officer (SSO) and will be immediately communicated to appropriate personnel. This HASP is intended to be in compliance with 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response; Final Rule."

This HASP is structured, and may be presented, as a stand alone document. However, it may also be used in conjunction with previously generated site-specific Health and Safety documentation. If this document is used in conjunction with other documentation, and conflicting information becomes evident, the most stringent or conservative will take precedence.

2.0 BACKGROUND

2.1 ACTIVITY LOCATION

Naval Weapons Industrial Reserve Plant (NWIRP) Calverton is located at the eastern end of Long Island, in Suffolk County, New York. It covers almost 6,000 acres, a portion in the town of Riverhead and the remaining part is in Brookhaven. Refer to Figures 2-1 and 2-2.

2.2 ACTIVITY MISSION AND HISTORY

The mission of NWIRP Calverton is to assemble, develop, and flight-test aircraft for the U.S. military. (NWIRP Bethpage manufactures many of the components assembled and tested at NWIRP Calverton.)

NWIRP Calverton was built during the Korean War. Construction was completed in 1954. Its mission continues to be the assembly, testing, refitting, and retrofitting of Naval aircraft. The Department of Navy personnel oversees the work done by civilian experts and technicians employed by Grumman Aerospace Corporation (Grumman).

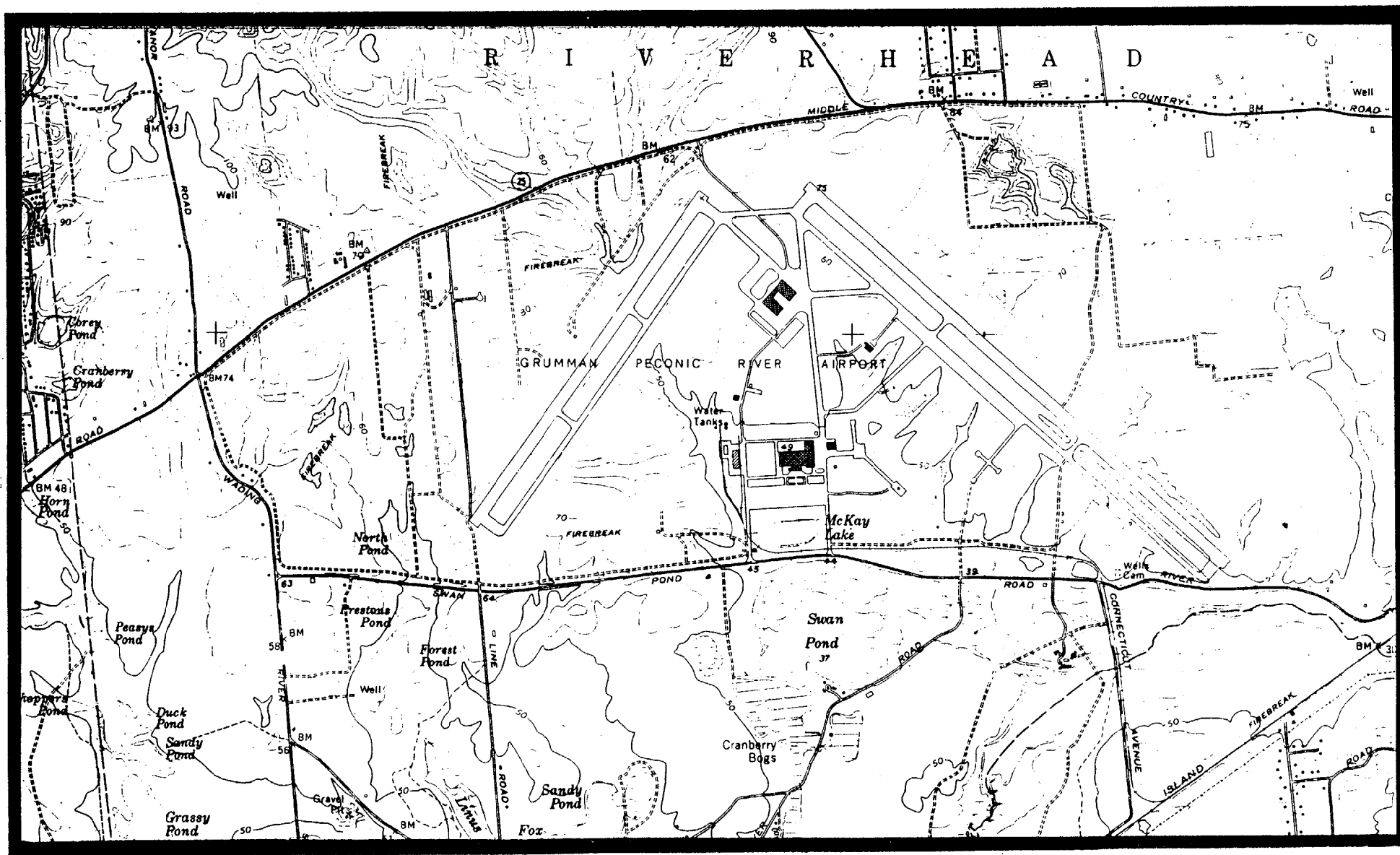
NWIRP Calverton is a Government Owned Contractor Operated (GOCO) activity operated by the Grumman Aerospace Corporation. The facility covers 11 square miles, most of which is owned by the Navy. Plant 08 (an avionics test building) and its guard booth are the only structures situated on land owned by Grumman (General Plan, March 1985).

2.3 BACKGROUND OF SPECIFIC SITES TO BE INVESTIGATED

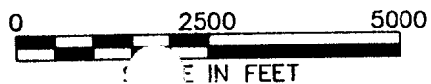
2.3.1 Site 1: Northeast Pond Disposal Area

The NWIRP Calverton Northeast Pond Disposal Area (Figure 2-3) is located in the northeastern portion of the activity. The area of contamination is located south of Middle County Road (Route 25) and 5,000 feet east of the north gate of the activity.

Aerial photographs taken between 1947 and 1984 indicate that the area was active more or less continuously from 1947 through about 1984.



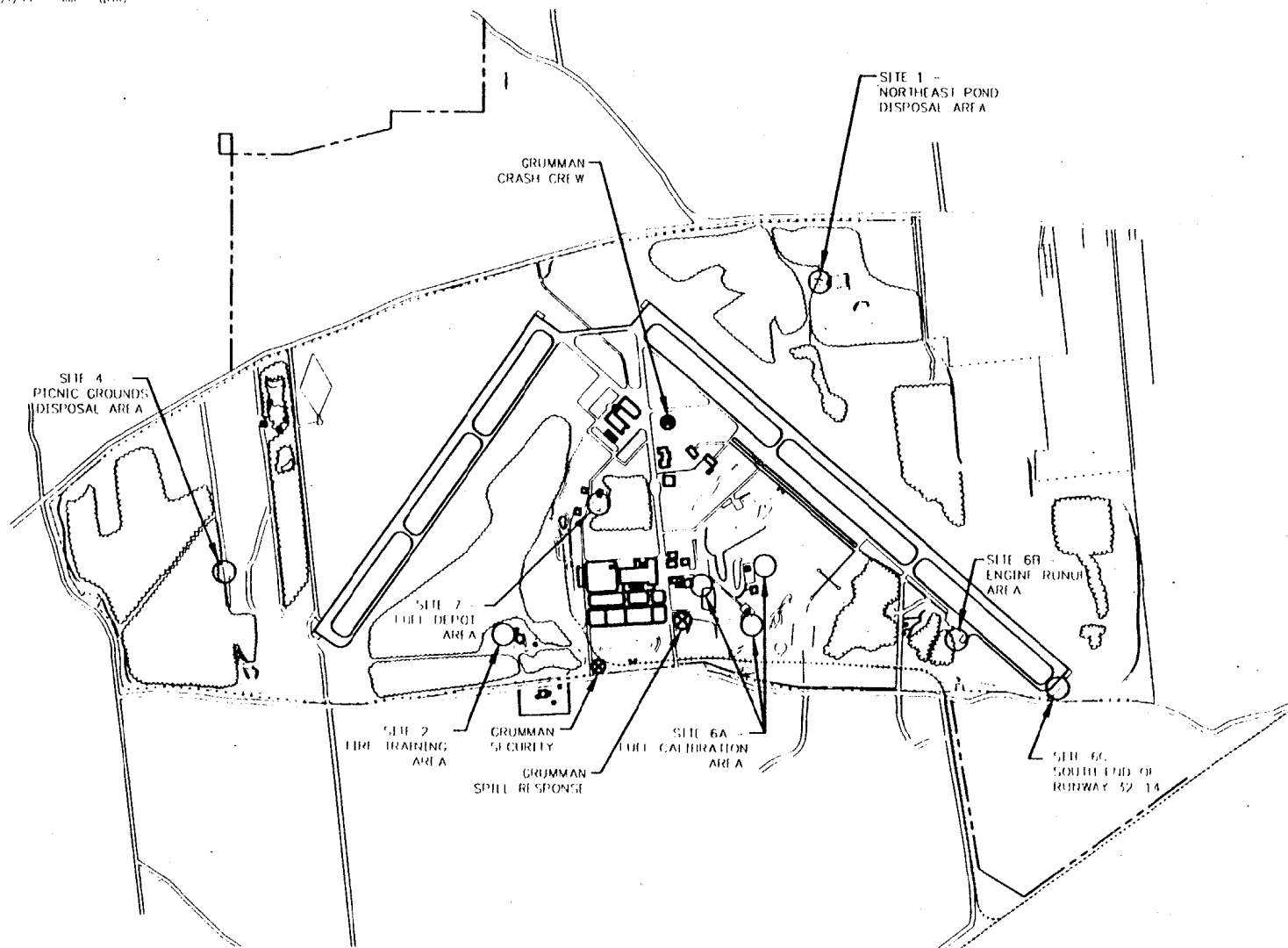
USGS QUADRANGLE: WADING RIVER 1967

SITE LOCATIONNWIRP, CALVERTON, NEW YORK

HALLIBURTON NUS
Environmental Corporation

FIGURE 2-1

D-5



**LOCATION OF ON SITE
EMERGENCY RESPONSE FACILITIES
NWIRP, CALVERTON, NY**

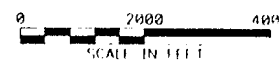


FIGURE 2-2

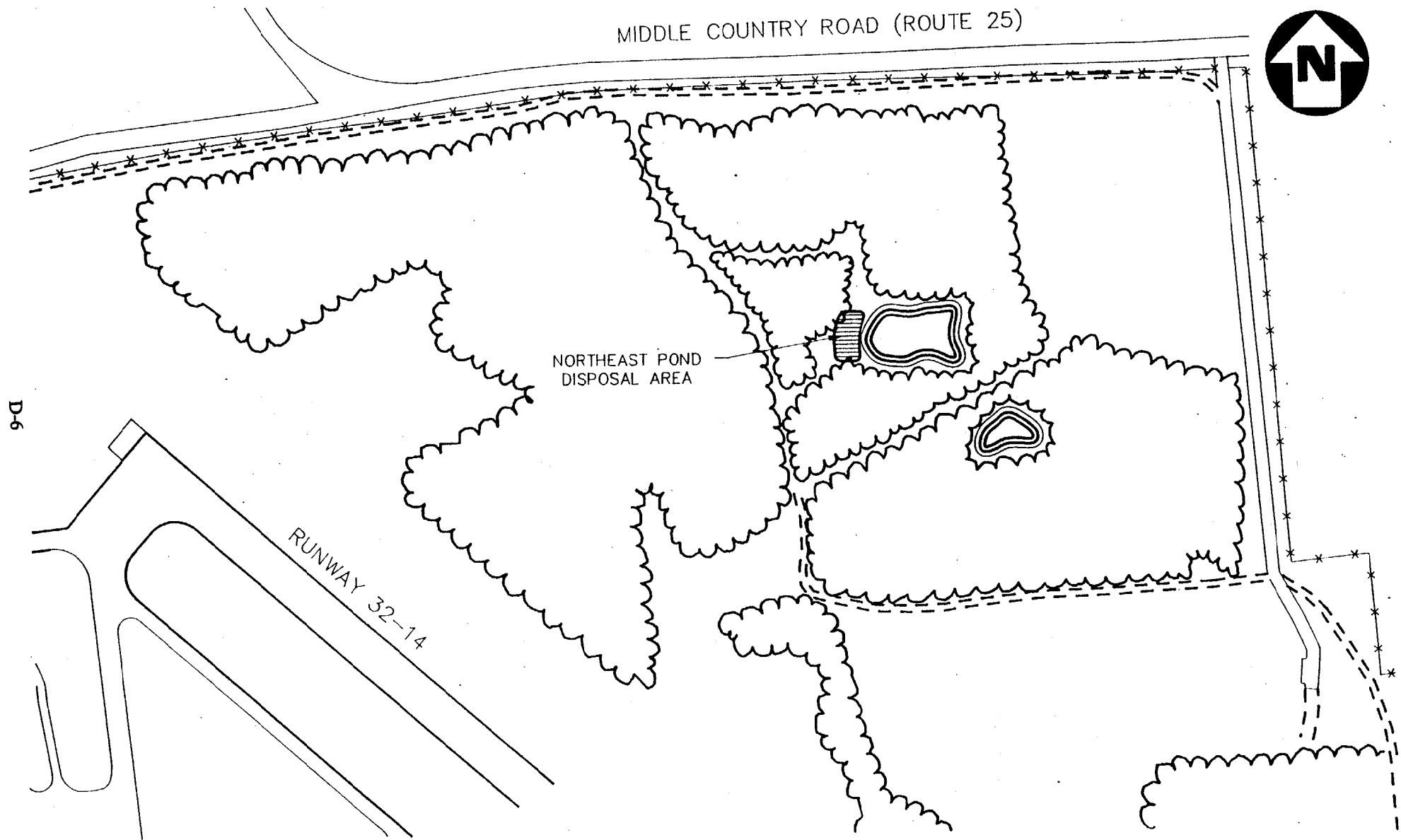


FIGURE 2-3

SITE LAYOUT
SITE 1 - NORTHEAST POND DISPOSAL AREA

NWIRP, CALVERTON, NEW YORK

The Preliminary Assessment estimated that the thickness of the disposed material is approximately 20 feet and the estimated volume of the site is 7,500 cubic yards of debris and cover material.

The following types of disposed material at the site have been documented in the Preliminary Assessment: a cockpit portion of an aircraft fuselage fabricated primarily of aluminum and metal components; a large number of concrete columns; piles of asphalt macadam, plywood, and framing lumber; scraps of rusting metal parts; hulks of several 5-gallon pails and numerous 1-gallon paint pails containing small amounts of paint residues.

Contaminated fill material and contamination of the sediments and surface water adjacent to Site 1 were found during the Site Investigation. Primary contaminants were inorganics and limited concentrations of volatile organics. Waste material at the site was found to extend from near the surface down and into the groundwater table.

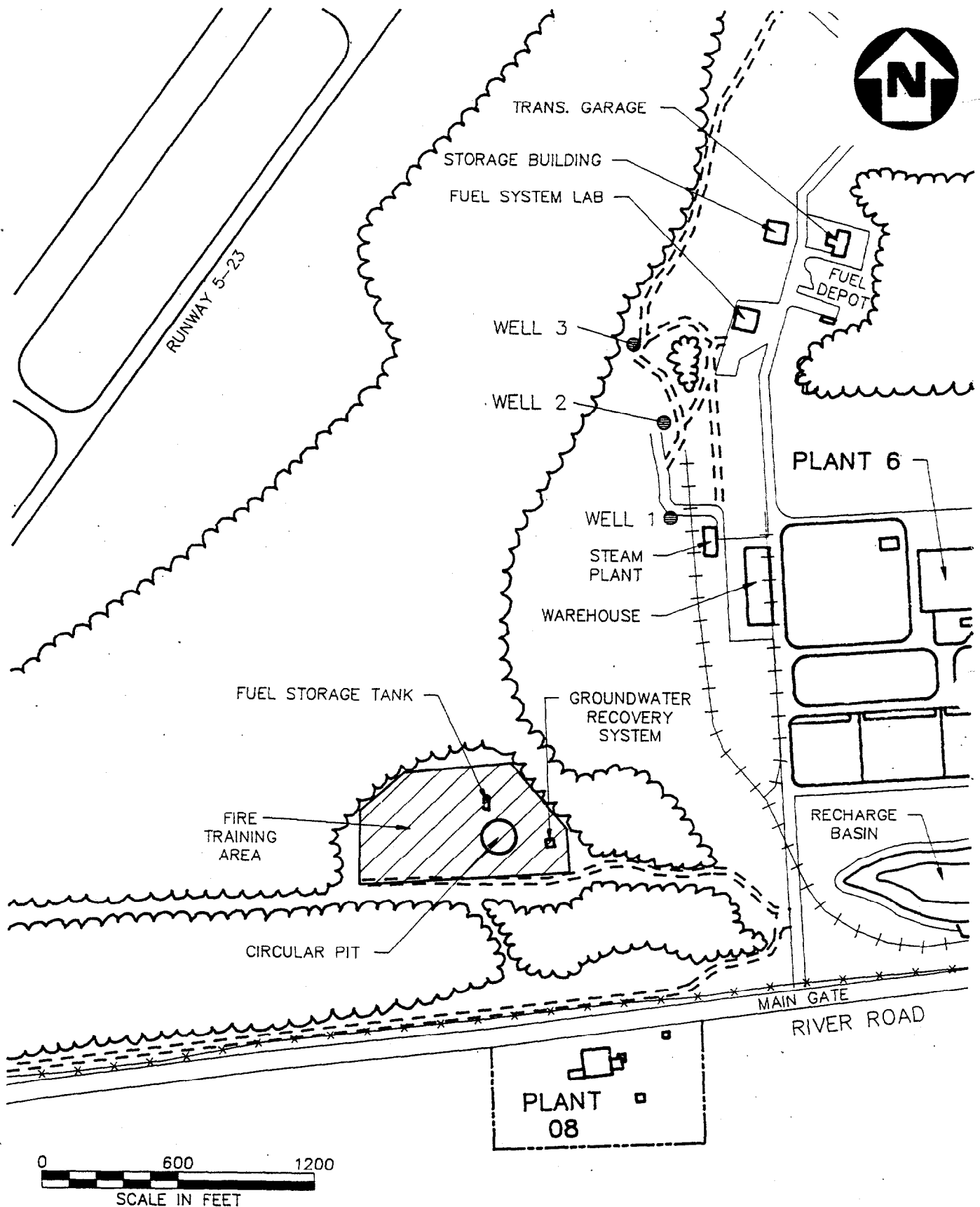
2.3.2 Site 2: Fire Training Area

The Fire Training Area (Figure 2-4) has been used exclusively by the Grumman Crash Crew and other fire fighting personnel at NWIRP Calverton since 1952. Fire Training Area appears to be a bermed ring created from site soils. This early gaining ring was unlined. For training exercises, this ring was partially filled with water and a layer of fuel was floated on top of the water. This fuel layer was ignited to provide fire fighting practice. An estimated 450 gallons per year of solvent [including toluene, methylethyl ketone (MEK), and lacquer thinner] were disposed of in this manner from 1953 to 1975. An estimated 1,500 to 2,000 gallons per year of waste fuel oils were mixed with the disposed solvents and burned at the site. This practice was stopped in 1975. Reportedly, since 1975 personnel have burned only clean (unmixed) fuel.

Two spills of fuel oil occurred in 1982 and 1983. One spill originated from a 6,000-gallon underground oil supply tank used for the exercises; and the other spill (1983) involved 300 gallons from another storage tank in this area.

The entire Fire Training Area has been upgraded with concrete berms installed to contain the oil and water used in the training exercises. The piping was modified to prevent spills and a direct line was installed between the storage tank and the training area. The underground 6,000-gallon tank was removed and replaced by an aboveground 1,000-gallon tank.

Hazardous wastes potentially present at the site include petroleum oil lubricants (POLs), toluene, and methylethyl ketone and soluble leads from gasoline burned during the exercises. There is also a potential for buried drums of unknown content to be at this site.



SITE LAYOUT
SITE 2 - FIRE TRAINING AREA
NWIRP, CALVERTON, NEW YORK

FIGURE 2-4



HALLIBURTON NUS
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The presence of contaminated soil and groundwater at Site 2 was confirmed in the Site Investigation. Primary contaminants are chlorinated and nonchlorinated volatile organics with lesser concentrations of semivolatile organics and inorganics. Low concentrations of PCBs and pesticides were also found.

2.3.3 Site 6A: Fuel Calibration Area

This area is where newly assembled aircraft receive preflight testing (refer to Figure 2-5). This testing includes the fuel delivery system and the engine. The engine is operated at high speeds for periods long enough to ensure that these systems are fuel-tight and are ready for continuous service. Fuel leakage usually occurs when the systems are first pressurized.

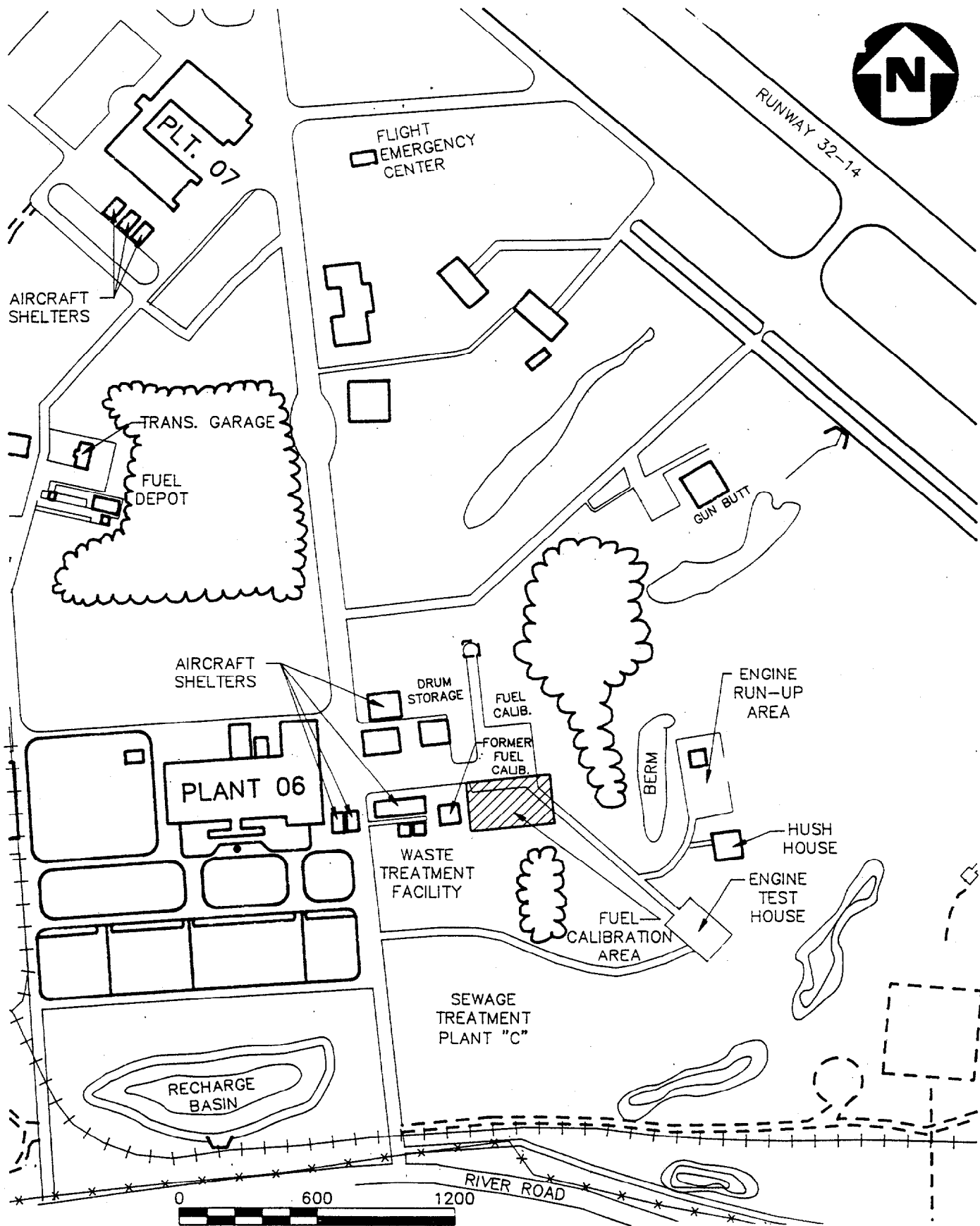
There have been three recorded spills at these sites in the years between 1982-1984. In 1982, about 200 gallons of JP-5 (Jet Fuel) spilled at the Engine Test House. In 1983, 30 gallons of JP-5 was spilled on the ground at the Engine Run-Up Area. In 1984, an unknown amount of oil and water in a mixture spilled at the Fuel Calibration Area.

The presence of soil and groundwater contamination was confirmed during the Site Investigation. Primarily chlorinated and nonchlorinated volatile organics and semivolatile organics were found. Lead contamination of the groundwater was also observed.

2.3.4 Site 7: Fuel Depot

This site has experienced numerous spills during fueling/refueling operations at Calverton (refer to Figure 2-6). A total of 30 wells have been installed which monitor the contamination. In addition, a recovery well system is being designed to recover the product which is expected to be a light non-aqueous product (mostly diesel and gasoline).

The Site Investigation indicated the presence of groundwater contamination. Primary contaminants found were non-chlorinated volatile organics and lead.

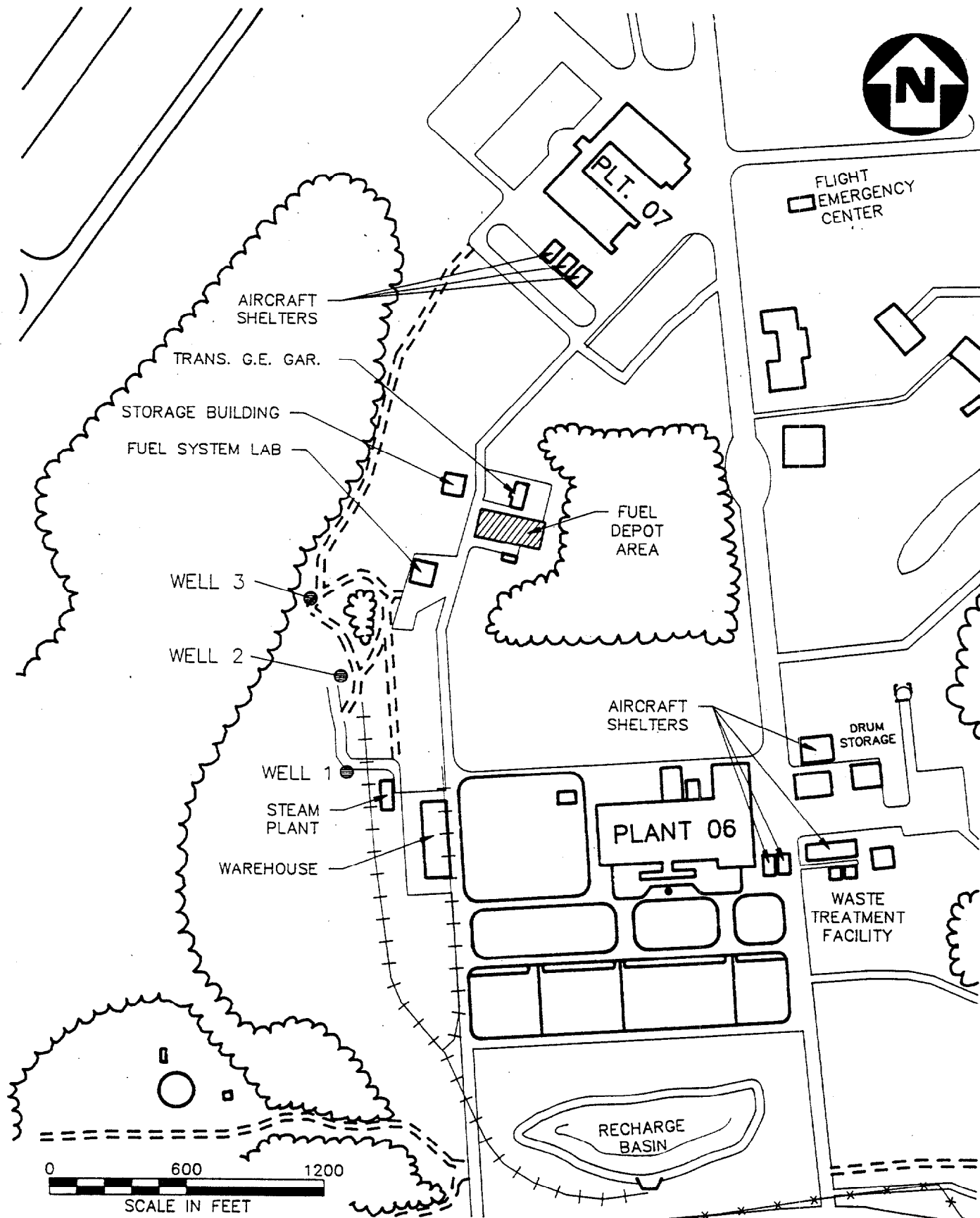


SITE 6A - FUEL CALIBRATION AREA

NWIRP. CALVERTON, NEW YORK



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SITE LAYOUT
SITE 7 - FUEL DEPOT AREA

NWIRP, CALVERTON, NEW YORK

FIGURE 2-6



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3.0 SCOPE OF WORK

3.1 SITES TO BE INVESTIGATED

The investigations will be performed at the four individual remote locations as determined as a result of the initial site investigation. The site-specific field activities for the investigation are presented in Table 3-1. The locations of the sites are shown in Figure 2-2.

TABLE 3-1

**SUMMARY OF SITE-SPECIFIC FIELD ACTIVITIES FOR RFI
NWIRP CALVERTON, LONG ISLAND, NEW YORK**

Activity	Site 1 Northeast Pond Disposal Area	Site 2 Fire Training Area	Site 6A Fuel Calibration Area	Site 7 Fuel Depot Area
Soil Gas Survey		X	X	X
Geophysical Survey		X		
Test pit Excavation	X	X		
Subsurface Soil Borings	X	X	X	X
Temporary Wells/Field-based groundwater sampling and analysis		X	X	X
Monitoring Well Drilling and Installation	X	X	X	X
Surface Soil Sampling	X	X	X	
Surface Water/Sediment Sampling	X			
Waste Sampling	X	X		
Monitoring Well/Groundwater Sampling	X	X	X	X
Staff Gauges	X			
Water Level Measurement	X	X	X	X
Site Survey	X	X	X	X
Aquifer Testing	X	X	X	X

4.0 RISK ANALYSIS

4.1 CHEMICAL HAZARDS

Site-specific chemical hazards associated with field work are analyzed in the following section. This section evaluates suspected contaminants based on past disposal practices. Specific contaminants known or suspected to be on each site are discussed in Section 4.2 (See Table 4-1).

4.1.1 Site 1: Northeast Pond Disposal Area

Scope of Work: Test pit excavation; subsurface soil borings; monitoring well drilling and installation; surface water, sediment, soil, and groundwater sampling; waste sampling; staff gauge installation; water level measurement; site survey; and aquifer testing.

Suspected Contaminants: Construction debris, bulks of several 5-gallon pails, numerous 1-gallon paint pails containing small amounts of paint residue.

Risk Analysis: Moderate - potential exposure via skin absorption, eye contact, inhalation. Physical hazards typical of drilling and backhoe/test pit operations may also be encountered including: encountering flammable vapors or underground/overhead utilities; contact with moving/rotating machinery; manual lifting of heavy objects; noise in excess of 85 dBA; and working from elevated working surfaces.

4.1.2 Site 2: Fire Training Area

Scope of Work: Soil gas and geophysical surveys, test pit excavation, soil borings, temporary well installation, monitoring well drilling and installation, soil and groundwater sampling, water level measurement, site surveying, and aquifer testing. Test pitting activities at the Fire Training Area (Site 2) will be preceded by a geophysical survey to identify test pit locations. Areas identified as potentially containing buried drums will be excavated to quantify the amount of buried waste. Any drum uncovered will not be opened, sampled, extracted from the test pit or disturbed in any fashion. Due to the nature of this task, and the unknowns concerning the existence, location, and potential contents of these drums. This exercise will proceed with extreme caution to avoid disturbing the drums and the soils supporting them.

Suspected Contaminants: Petroleum, oil, and lubricants (POLs), toluene, MEK, soluble leads from gasoline, and PCBs.

Risk Analysis: Moderate - potential exposure via all routes of entry. Special precautions should be taken when sampling free-phase product layer in monitoring well and in soil disturbing activities due to potential lead content. Physical hazards typical of drilling and backhoe/test pit operations may also be encountered including: encountering flammable vapors or underground/overhead utilities; contact with moving/rotating machinery; manual lifting of heavy objects; noise in excess of 85 dBA; and working from elevated working surfaces.

4.1.3 Site 6A: Fuel Calibration Area

Scope of Work: Soil gas survey, soil borings, temporary well installation, monitoring well drilling and installation, soil and groundwater sampling, water level measurement, site survey, and aquifer testing.

Suspected Contaminants: JP-5 (jet fuel), oil. Note: In 1984 an unknown amount of soil and water in a mixture spilled at the fuel calibration area.

Risk Analysis: Low to moderate - potential exposure via inhalation, skin absorption. Special precautions should be taken when sampling free-phase product layer in monitoring well. Physical hazards typical of drilling operations may also be encountered including: encountering flammable vapors or underground/overhead utilities; contact with moving/rotating machinery; manual lifting of heavy objects; noise in excess of 85 dBA; and working from elevated working surfaces.

4.1.4 Site 7: Fuel Depot

Scope of Work: Soil gas survey, soil borings, temporary well installation, monitoring well drilling and installation, groundwater sampling, water level measurement, site survey, and aquifer testing.

Suspected Contaminants: diesel, gasoline, lead (from gasoline).

Risk Analysis: Moderate - due to free-phase product layer, special precautions will be necessary. Physical hazards typical of drilling operations may also be encountered including: encountering flammable vapors or underground/overhead utilities; contact with moving/rotating machinery; manual lifting of heavy objects; noise in excess of 85 dBA; and working from elevated working surfaces.

The primary hazards associated with this investigation include potential exposure to petroleum and petroleum products, solvent (e.g. paints, toluene, MEK), and JP-5 jet fuel, via direct skin/eye contact; inhalation of vapors from these same products; and inhalation/ingestion of various metals such as lead via suspended airborne particulates. Table 4-1 presents the contaminants known or suspected to be present on each site and also outlines relevant toxicity data.

The use of real-time air monitoring instruments, visual observation, olfactory observation and personnel's perception of irritation will aid in the early detection and possibly avoidance of exposure to site contaminants. Personal protective equipment (PPE) and standard work practices, Sections 6.0 and 12.0 of this plan, respectively, will be used when necessary to help reduce or eliminate exposures and therefore, reduce the potential for adverse health effects. Another potential hazard is the generation of a flammable atmosphere that could exist as a result of emissions from testpits, wells, or boreholes. Because of this potential, it will be necessary to periodically monitor for combustible atmospheres within such enclosed spaces. Action levels regarding combustible gas/vapor monitoring are presented in Section 5.0.

During the execution of the scope of work (see section 3.0) certain physical hazards may be encountered while engaged in onsite activities. Based on the hazard analyses of each task and operation, it is anticipated that physical hazards could be encountered. Examples of these may include:

- Contact with energized sources
- Exposure to moving machinery, particularly during drilling activities
- Uneven or unstable terrain (slip, trip, and fall hazards)
- Strain, Sprains or muscle pulls
- Noise in excess of 85 dBA
- Falls from elevated surfaces
- Heat stress (particularly if chemical protective coveralls are worn in warm/hot weather)
- Cold stress (In cold weather)
- Working on or near waters edge
- Inclement weather
- Pressurized Systems

TABLE 4-1
CONTAMINANTS OF CONCERN
NWIRP CALVERTON, LONG ISLAND, NEW YORK

Substance	CAS No. ⁽¹⁾	Physical Description and Odor (Virgin State)	PEL TWA ⁽²⁾	Route of Exposure	Symptoms of Overexposure	Site No./ Media ⁽³⁾
Aldrin	309-00-2	Colorless to dark brown crystalline solid with a mild chemical odor.	0.25 mg/m ³ Ca ⁽⁴⁾	Inhalation Ingestion Absorption Skin/Eye Contact	Headache; dizziness; nausea; vomiting; coma.	2/S
Aroclor 1248 (as Aroclor 1242)	53469-21-9	Colorless to light colored, viscous liquid with a mild hydrocarbon odor.	NIOSH/0.001 mg/m ³ ; OSHA/1 mg/m ³ Ca ⁽⁴⁾	Inhalation Absorption Ingestion Skin/Eye Contact	Eye irritant; chloracne; liver damage.	2/S
Aroclor 1260 (as Aroclor 1254)	11097-69-1	Colorless to pale yellow, viscous liquid with a mild hydrocarbon odor.	NIOSH/0.001 mg/m ³ ; OSHA/0.5 mg/m ³ Ca ⁽⁴⁾	Inhalation Absorption Ingestion Skin/Eye Contact	Eye irritant; acne-form dermatitis.	2/S,GW
Chloroethane	75-00-3	Colorless gas or liquid with a pungent ether-like odor.	1000 ppm	Inhalation Absorption Ingestion Skin/Eye Contact	Inebriate; abdominal cramps; cardiac arrest; liver, kidney damage.	2/S,GW; 6A/GW
DDT	50-29-3	Colorless solid with weak chemical odor.	1 mg/m ³ Ca ⁽⁴⁾	Inhalation Ingestion Absorption Skin/Eye Contact	Sleepiness; headache; dizziness, eye and skin irritant; vomiting; tremors; convulsions.	2/S
1,2-Dichlorobenzene (O-DCB)	95-50-1	Colorless to pale yellow liquid with a pleasant aromatic odor (herbicide).	Ceiling 50 ppm Intended changes; 25 ppm	Inhalation Absorption Ingestion Skin/Eye Contact	Irritating to the eyes and nose; liver damage; skin blisters.	2/GW
1,1-Dichloroethane	75-34-3	Colorless oily liquid with a chloroform-like odor.	100 ppm	Inhalation Ingestion Skin/Eye Contact	Central nervous system (CNS) depression, irritating to skin.	1/S; 2/GW; 6A/GW

TABLE 4-1 (cont'd)
CONTAMINANTS OF CONCERN
NWIRP CALVERTON, NEW YORK

Substance	CAS No. ⁽¹⁾	Physical Description and Odor (Virgin State)	PEL TWA ⁽²⁾	Route of Exposure	Symptoms of Overexposure	Site No./ Media ⁽³⁾
1,2-Dichloroethane	107-06-02	Clear liquid with sweet odor like chloroform.	10 ppm	Inhalation Ingestion Absorption Skin/Eye Contact	CNS depression; nausea; vomiting; eye irritant; visual impairment.	1/S
1,2-Dichloroethene	540-57-0	Colorless liquid with a slightly acrid, chloroform-like odor.	200 ppm	Inhalation Ingestion Skin/Eye Contact	Irritating to eyes and respiratory system; CNS depression.	2/GW; 7/S
Endrin	72-20-8	Colorless to tan crystalline solid with a mild chemical odor	0.1 mg/m ³	Inhalation Absorption Ingestion Skin/Eye Contact	Stupor, head, dizziness; discomfort, nausea, vomiting; aggressiveness; lethargy, weak.	2/S
Ethylbenzene	100-41-4	Colorless liquid with an aromatic odor.	100 ppm	Inhalation Skin/Eye Contact	Irritating to eyes and mucous membrane; headache; dermatitis.	1/S; 2/S,GW; 7/GW; 6A/S
Jet Fuel (JP-5)	mixture	Nearly colorless with a kerosene-like odor	None established	Inhalation Adsorption	Irritating to eyes and nose; throat dermatitis.	6A;7
Methyl-ethyl-ketone (MEK)	78-93-3	Colorless liquid with a sharp mint-like odor.	200 ppm	Inhalation Ingestion Skin/Eye Contact	Irritating to eyes and nose; headache; dizziness; vomiting.	2
Methylene chloride	75-09-2	Colorless liquid with a chloroform-like odor.	500 ppm, lowest possible conc., Ca ⁽⁴⁾	Inhalation Ingestion Skin/Eye Contact	Fatigue; weakness; sleepiness; light-headedness; irritating to eyes and skin; numb limbs.	6A/S
Naphthalene	91-20-3	Colorless to brown solid with an odor of mothballs.	10 ppm	Inhalation Adsorption Ingestion Skin/Eye Contact	Eye irritation; headache; confusion; vomiting, abdominal pain; profuse sweat.	1/S; 6A/S
Tetrachloroethene (PCE)	127-18-4	Colorless liquid with a mild chloroform-like odor.	NIOSH-lowest feasible OSHA-25 ppm	Inhalation Ingestion Skin/Eye Contact	Irritating to the eyes, nose, throat; nausea; flush face and neck; dizziness; headache.	2/S, GW

TABLE 4-1 (cont'd)
CONTAMINANTS OF CONCERN
NWIRP CALVERTON, NEW YORK

Substance	CAS No. ⁽¹⁾	Physical Description and Odor (Virgin State)	PEL TWA ⁽²⁾	Route of Exposure	Symptoms of Overexposure	Site No./ Media ⁽³⁾
1,1,1-Trichloroethane (TCA)	71-55-6	Colorless liquid with a mild chloroform-like odor.	Ceiling 350 ppm	Inhalation Ingestion Skin/Eye Contact	Headache; lassitude; CNS depression; irritating to eyes and skin.	2/S,GW; 6A/S,GW
Trichloroethene (TCE)	79-01-6	Colorless liquid with a chloroform-like odor/	25 ppm Ca ⁽⁴⁾	Inhalation Ingestion Skin/Eye Contact	Headache; visual disturbance; tremors, nausea; eye irritant; dermatitis.	2/S,GW
Toluene	108-88-3	Colorless liquid with a sweet, pungent, benzene-like odor.	100 ppm	Inhalation Ingestion Absorption Skin/Eye Contact	Fatigue; weakness; confusion; dizziness; headache; dermatitis.	1/S; 2/S,GW; 6A/S,GW; 7/GW
Xylenes	1330-20-7	Colorless liquids with an aromatic odor.	100 ppm	Inhalation Ingestion Absorption Skin/Eye Contact	Dizziness; excitement, drowsiness; irritating to eyes, nose, and throat; nausea; vomiting.	2/S,GW; 6A/S,GW; 7/GW
Arsenic	7740-38-2	Metal: silver-gray or tin-white, brittle, odorless	NIOSH ceiling 0.002 mg/m ³ Ca ⁽⁴⁾	Inhalation Adsorption Ingestion Skin/Eye Contact	Ulceration of nasal septum, dermatitis, GI disturbances, respiratory irritation	1/S; 2/GW
Barium	10022-31-8	White odorless solid.	0.5 mg/m ³	Inhalation Ingestion Skin/Eye Contact	Upper respiratory irritation; muscle spasms; slow pulse; irritation to eyes; skin burns.	1/S; 2/GW
Cadmium (dust)	7440-43-9	Metal: silver-white, blue-tinged lustrous, odorless solid.	NIOSH-lowest feasible concentration ACGIH-0.05 mg/m ³ Ca ⁽⁴⁾	Inhalation Ingestion	Pulmonary edema; cough; tight chest; headache; chills; nausea; vomiting; diarrhea.	1/S; 2/S,GW
Chromium	7440-47-3	Blue-white to steel-gray, lustrous, brittle, hard solid.	0.5 mg/m ³	Inhalation Ingestion	Histologic fibrosis of the lungs.	1/S,Sd; 2/GW
Copper (dust)	7440-50-8	Reddish, lustrous, malleable, odorless solid.	1 mg/m ³	Inhalation Ingestion Skin/Eye Contact	Irritant to nasal mucous membrane; eye irritation; metallic taste.	1/S,Sd,SW; 2/S

TABLE 4-1 (cont'd)
CONTAMINANTS OF CONCERN
NWIRP CALVERTON, NEW YORK

Substance	CAS No. ⁽¹⁾	Physical Description and Odor (Virgin State)	PEL TWA ⁽²⁾	Route of Exposure	Symptoms of Overexposure	Site No./ Media ⁽³⁾
Cyanide		In compound, white granular or crystalline solids with a faint almond-like odor.	5 mg/m ³	Inhalation Absorption Ingestion Skin/Eye Contact	Asphy and death can occur; weak, headache, confusion; nausea, vomiting; irritant to eyes and skin.	1/S,SW; 2/GW
Lead	7439-92-1	Metal: a heavy, ductile, soft gray solid.	0.050 mg/m ³ Ca ⁽⁴⁾	Inhalation Ingestion Skin/Eye Contact	Weakness; lassitude; insomnia; pallor; abdominal pain; hypertension; eye irritant.	1/S,SW; 2/S,GW; 6/S,GW; 7/GW
Nickel	7440-02-0	Metal: lustrous, silvery solid.	0.015 mg/m ³ Ca ⁽⁴⁾	Inhalation Ingestion Skin/Eye Contact	Headache; nausea; vomiting; cough; weakness.	1/S,GW
Zinc (as Zinc Oxide)	1314-13-2	Fine white, odorless particulate dispersed in air.	5 mg/m ³	Inhalation	Sweet metallic taste; dry throat, cough; chills, fever; blurred vision; muscle cramps; nausea, vomiting.	1/S,Sd,SW; 2/S,GW

- (1) Chemical Abstract Number
- (2) Permissible Exposure Level established by the Occupational Safety and Health Administration (OSHA).
- (3) Media in which the substance was detected during the Site Investigation. Media designations: S - Soil; GW - Groundwater; SW - Surface Water; Sd - Sediment.
- (4) Considered to be an occupational carcinogen by the National Institute for Occupational Safety and Health (NIOSH).

ACGIH American Conference of Governmental Industrial Hygienists
 CNS Central Nervous System
 GI Gastrointestinal

Control efforts for these potential hazards shall employ a variety of safety measures to mitigate these hazards. These hazards and control measures shall be discussed individually in each area mentioned above.

4.3.1 Contact with Energized Sources

To avoid hazards of this type, no drilling mast or any other such projecting items shall be permitted within a 20-foot radius of any energized source. Also, any areas targeted for subsurface activities shall first be investigated to determine the presence of underground utilities.

4.3.2 Exposure to Moving Machinery

Personnel shall also be advised of the hazards presented due to working in a close proximity of moving machinery (i.e. drill rig). Safety measures employed to overt hazards of this nature will include: using only proper fitting personal protective equipment to avoid possible entanglement in moving parts; employing lockout/tagout procedures prior to performing maintenance functions on equipment; and lastly, all equipment, prior to use, then periodically afterwards will be inspected by the SSO or their onsite representative to ensure all guards, protective cages, and emergency shut-off devices are in place and functioning properly. All equipment (i.e. hand tools, portable power tools), and machinery on site (i.e., drill rigs) will be kept properly maintained, positioned, guarded, and operated. All maintenance performed on equipment shall be done so in accordance with manufacturer's specifications.

4.3.3 Uneven or Unstable Terrain

During the monitoring well installation, surface water/sediment sampling, or staff gauge installation there is potential for slip, trip, and falls associated with wet, steep or unstable banks and sediment surfaces along creeks, ditches, and the disposal pond and other areas associated with this scope of work. To minimize the hazards of this nature, personnel required to work in and along areas prone to these types of hazards will be required to employ life lines and/or safety harnesses, ring buoys and other means of personnel extraction suitable for the task at hand. All sampling conducted will be performed utilizing the Buddy system with one member of the team in position for extraction.

4.3.4 Strain, Sprains and/or Muscle Pulls

During execution of this scope of work there is potential for strains, sprains and/or muscle pulls due to the physical demands and nature of this task. To avoid injury, during lifting tasks personnel are to lift with the force

of the load carried by their legs and not their backs. When lifting or handling heavy material or equipment, use an appropriate number of personnel. Keep the work area free from ground clutter. Use gravel or sand where necessary and feasible to improve traction. Due to the type of environment/topography (soft muck, swampy type environment in some locations), locomotion and operation will be extremely difficult. These conditions increase hazard potential and make even small jobs more difficult. Therefore extreme caution and best professional judgement should be exercised to mitigate these hazards as they are encountered.

4.3.5 Noise in Excess of 85 dBA

Due to the nature of the scope of work, and the various machinery and tools planned to be used, the potential exists that noise in excess of 85 dBA will be encountered. As a precautionary measure, hearing protection will be available on site and required for use during heavy equipment operation (i.e. drill rigs, backhoes, etc.) and during other tasks should it be deemed necessary. The SSO will determine the need to conduct a noise survey of operations. In the event the results of such a survey identify potential personnel exposures to excessive noise levels, a site Hearing Conservation Program (in accordance with HS2.13, Appendix B) shall be developed and implemented in accordance with OSHA Regulation 29 CFR 1910.95.

4.3.6 Falls from Elevated Surfaces

Although no activities from elevated surfaces are planned the potential for this hazard may exist in activities such as test pitting activities, and should maintenance needs require someone to climb the drill rig mast. During test pitting activities, personnel shall maintain a minimum distance of 2 feet from the pit to avoid the potential of falling into the pit in the event of a cave-in. Personnel are not permitted, under any circumstances, to enter the test pit to retrieve a sample or otherwise. Also, during excavation, personnel shall maintain a distance of the full length of the extended boom plus 3 feet. All test pits will be adequately barricaded to prevent access. No test pits will be left unattended. Any activity conducted at a level greater than four (4) feet above the ground surface will require the use of ANSI fall protection, as applicable.

4.3.7 Heat Stress

As this scope of work will require personnel to employ personal protective equipment (PPE) as a means of protection from both chemical and physical hazards, the potential for heat related disorders during the proposed

field dates is significant. To combat this problem the Project Manager and the Health and Safety Officer shall initiate heat stress monitoring, and effect the appropriate control efforts, in accordance with Halliburton NUS Standard Operating Procedures HS-09 "Heat Stress Control", (a copy of which is included as Attachment D-I), and the ACGIH recommended control measures, included in the same attachment.

4.3.8 Cold Stress

Cold stress information is presented in Attachment D-I is intended to protect field personnel from injury due working in cold climates or from immersion in low temperature water. This information is presented by the ACGIH encompassing definitions, signs and symptoms of overexposure, evaluation and control for working in cold climates. Due to the location, and proposed time schedule for field activities, cold stress may become a possibility.

4.3.9 Water Hazards

In the execution of this scope of work, there are planned activities which may be only accessible by boat or along waters edge. To avoid potential hazards associated with working on waters edge or over water (drowning) the field team shall employ life lines, safety harnesses, and U.S Coast Guard approved personal flotation devices when working on or within four feet of the water. As stated earlier, some of these devices may be used for other reasons within this scope of work. However the objective, when on or near water, is for reasons such as emergency rescue and quick, effective personnel extraction. All activities on water or at waters edge will be terminated should inclement weather conditions arise. This will be at the discretion and direction of the field operations leader and the on site health and safety representative.

4.3.10 Inclement Weather

As all work will be conducted outdoors, inclement weather may be encountered. As conditions may vary, it will be at the discretion of the field team leader and acting health and safety representative on the team to terminate work or continue work if these conditions present themselves. All activities shall be terminated in the event of electrical storms.

4.3.11 Pressurized Systems

Utilization of the OVA Model 128 will require the use of hydrogen supplied in pressurized cylinders. In addition, should the Level of protection be elevated to Level B it will require the onsite personnel to handle

pressurize cylinders. To mitigate the possible effects of hazards of this nature, all cylinders delivered for use at the site will have met the requirements established for pressurized cylinders by DOT including inspection, validation, and documentation. All cylinders will be securely fastened in the upright position. All personnel required to handle cylinders should seek help as necessary for moving, staging and filling as applicable.

Additional control measures for these physical hazards are included in Section 12.0, "Standard Work Practices," of this HASP.

5.0 AIR MONITORING AND ACTION LEVELS

5.1 AIR MONITORING REQUIREMENTS

This section presents the requirements for the use of real time monitoring instruments during site activities. It establishes the types of instruments to be used, techniques for their use, and action levels for employing the results obtained through their use. Additionally methods for instrument maintenance, and calibration are described. This section represents the primary mechanisms for the detection of site contaminants will be continuous monitoring with an organic vapor analyzer (OVA Model 128), and Photoionization Detector (PID) HNu PI-101 with an 11.7 eV lamp strength, the worker's sense of smell, and perception of irritation. Visual observation will aid in evaluating exposure to lead and possibly other contaminants which are in the form of (or could cling to) suspended particulates. Monitoring with an LEL/O₂ meter will also be necessary to identify potentially flammable and/or oxygen deficient atmospheres that could exist as a result of emissions generated by drilling and excavation operations. Monitoring should be conducted within the headspace of samples and boreholes to detect potential flammable conditions.

5.2 AIR MONITORING ACTION LEVELS

The air monitoring action levels presented are as follows:

LEL/O ₂ Meter <10% LEL	Continue Monitoring
LEL/O ₂ Meter 10-25% LEL	Continue Monitoring Remove All Ignition Sources Use Spark Proof Tools Level B Protection
LEL/O ₂ Meter >25% LEL	Stop Work until situation can be brought under safe parameters
LEL/O ₂ Meter <19.5% O ₂ , >23.5% O ₂	Level B Protection Stop work until safe limits may be reestablished
HNu or OVA \leq Background	Continue Monitoring
HNu or OVA > Background @ Source	Monitor breathing zones
HNu or OVA > Background @ Breathing Zone	Level C Protection
HNu or OVA > 5 Units @ Breathing Zone	Level B Protection

Visual observation	Eliminate emissions source or Level C Protection
Odors/irritation detected	Level C Protection
Odors/irritation detected with respirator	Level B Protection
Signs/Symptoms of overexposure	Stop Work

Background readings shall be determined at a location upwind from potential sources of emissions. Sources, such as within the borehole, excavated materials (sediment, and water), contaminated materials loading area/operation, and decontamination fluids and sediments shall be monitored continuously for off gas emissions. Worker breathing zones shall be monitored anytime potential sources of emissions are identified. Level C protection will include full-face or half-face air purifying respirators equipped with organic vapor acid gas cartridges and HEPA filters. Level B protection will include pressure-demand, supplied-air (airline or SCBA) respirators. The 5 ppm action level represented above indicates half of the TLV-TWA. This action level along with warning properties will allow early detection of some of the most volatile contaminants on the chemical inventory list.

5.3 FREQUENCY OF MONITORING

Monitoring shall be conducted continuously during all drilling operations and excavation within bore holes, test pits, and immediately over drill cuttings at every 5-foot depth interval, and periodically as work progresses and when there is potential for atmospheric change within the work area. Monitoring will be initiated at any potential source emissions, then moved to the worker's breathing zone if positive indications are observed at the source.

5.4 INSTRUMENT CALIBRATION AND MAINTENANCE

Air monitoring instruments are pre-field calibrated and maintained at the Halliburton NUS equipment warehouse. Field calibrations will be performed prior to each daily use in accordance with the manufacturers recommendations and Halliburton NUS Standard Operating Procedures. Field maintenance will consist of daily cleaning of the outer surfaces of the instruments with a damp cloth, replenishment of hydrogen (OVA), cleaning of the lamp with a dry lint-free cloth (HNU), and overnight charging of batteries.

All equipment maintenance and calibration efforts onsite shall be conducted by SSO, or his/her designee in accordance with the following Halliburton NUS Health and Safety Standard Operating Procedures. The provisions specified in the following Standard Operating Procedures will be observed:

- No. ME01: Use, Calibration, and Maintenance of HNu PI-101
- No. ME02: Use, Calibration, and Maintenance of OVA 128
- No. ME05: Combustible Gas Indicator

Copies of these guidance documents may be found in Attachment D-II.

5.5 INSTRUMENT CALIBRATION DOCUMENTATION

Results of instrument calibration performed in the field must be recorded on Table 5-1 and returned to the Health Sciences Department with the Site Health and Safety Follow-up Report.

5.6 DIRECT-READING INSTRUMENT RESPONSE DATA

Any readings obtained through the use of direct-reading instruments must be recorded throughout the duration of project activities. This information is to be recorded on Table 5-2 and returned to the Health Sciences Department with the Site Health and Safety Follow-up Report, at the conclusion of project site activities.

5.7 INSTRUMENT USE

The HNu, OVA, and the LEL/O₂ meters will be used primarily as screening tools during drilling, sampling or any other intrusive activity which might release emissions of toxic contaminants. Their selection is based on chemicals readily released into the environment.

5.8 VISUAL OBSERVATION

Based on the hazard assessment a large portion of the contaminants present will be in the form of a particulate. It is therefore assessed by controlling particulate generation and dispersal through work hygiene practices such as wetting down areas of potential dust generation this will act as a controlling factor of the contaminants.

5.9 MODIFICATION OF RESPIRATORY PROTECTION

LEVEL B:

Supplied air (SCBAs or line-air respirators) will be used under the following criteria:

- Anytime positive readings (5 ppm above measured background levels, sustained) are observed in the worker's breathing zone.

DIRECT-READING INSTRUMENT RESPONSE DATA

PROJECT NO. _____

OF _____

[illegible]

- Anytime a sweet, mint, or kerosene-like odor is perceived.
- Anytime irritation of the eyes, nose, throat or lungs is perceived by one or more of the team.
- Anytime work generates perceptible dust in the worker's breathing zone and one or more of the action levels in this section (in addition to this one) becomes evident, consequently deeming Level C unacceptable.
- Anytime there is potential for fire/explosion
- Anytime the airborne concentrations indicate that IDLH levels may be approached
- Anytime the selection criteria for wearing Air Purifying Respirators (APRs) has not been adequately met. This would include the following conditions:
 - Unidentified airborne substance
 - Unquantified airborne concentration/excessive concentrations (above the cartridges recommendation)
 - Oxygen deficient atmosphere <19.5%
 - No cartridge available for suspected/identified contaminant
 - No manufacturer's recommendation for use against that particular substance
 - Poor or inadequate warning properties

LEVEL C:

Full-face air purifying respirators (APR's) equipped with organic vapor/acid gas cartridges with HEPA filters (MSA's GMCH cartridge), shall be used in accordance with the following criteria:

- 0 ● Anytime work generates perceptible dust in the worker's breathing zone; unless dust can be controlled by other methods (e.g., wetting down areas of concern).
- Anytime it is suspected through warning properties, or monitoring instruments results that the airborne concentration have surpassed the action levels for level C protection as established in Section 5.2.

5.10 RESPIRATORY PROTECTION PROGRAM (APPENDIX C)

The Respiratory Protection Program (Appendix C) will be completed at project startup and will be modified (if needed) throughout the project.

6.0 PERSONAL PROTECTIVE EQUIPMENT (PPE)

This section presents requirements for the use of personal protective equipment (PPE) for each of the activities being conducted as defined in Section 3.0 of this HASP. This section includes anticipated levels of protection for each of the activities. Where activities overlap, the more protective equipment will apply.

6.1 PPE REQUIREMENTS (GENERAL)

All work is anticipated to be performed in a Level D Protection. As a minimum, all personnel must wear, standard field dress, steel toe/hard sole work boots and side shielded safety glasses while on site. Hard hats must be worn if personnel are within 20 feet of the drilling and drilling operations and/or if other conditions arise or exist where head protection may be necessary. Many activities will require the use of chemical resistant coveralls, gloves, and boot covers, as presented in the task breakdown in Section 6.3. In addition, it is possible that work will be upgraded to Level C (air-purifying respirators) or Level B (pressure-demand, supplied-air respirators) protection, depending on the results of air monitoring, site conditions, and task at hand as discussed in Section 5.0 of this HASP.

6.2 PPE REQUIREMENTS FOR DRILLERS AND ROUGHNECKS

All drilling personnel, and all other personnel who could come in contact with waste material, are required to wear, in addition to PPE listed above, standard Tyvek or PVC protective coveralls (whichever is applicable based on the physical state, amount and concentration), nitrile outer and inner gloves, boot covers, and taped ankle and wrist seams. PVC coveralls may be required if free-phase product, and/or heavily contaminated soil is encountered. Modification of PPE is at the discretion of the site safety officer (SSO).

6.3 PPE REQUIREMENTS FOR TASK/OPERATIONS

6.3.1 Soil Gas Survey (Sites 2, 6A, 7) and Geophysical Survey (Site 2)

Boot covers, nitrile outer and inner gloves, and standard coveralls are required for surveying along with the minimum requirements presented in Section 6.1.

6.3.2 Test Pit Excavation (Sites 1,2), Soil Borings, and Well Installation (Sites 1, 2, 6A, 7)

Particularly for personnel who could likely come in contact with soil or groundwater wastes, Tyvek coveralls, boot covers and nitrile outer and latex inner gloves are required along with the minimum requirements presented in Section 6.1.

6.3.3 Soil Sampling (Sites 1, 2, 6A)

Boot covers and nitrile outer and inner gloves are required for all soil sampling activities along with the minimum requirements presented in Section 6.1. Standard Tyvek protective coveralls are required if heavily-contaminated soils are encountered and should be used as needed to keep work clothes free of mud and water. PVC coveralls may be necessary if it is anticipated that free-phase product may be encountered.

6.3.4 Surface Water, Sediment, and Waste Sampling, and Staff Gauge (Site 1)

Personnel shall wear boot covers and nitrile inner gloves when conducting these sampling activities along with the minimum requirements presented in Section 6.1.

6.3.5 Groundwater Sampling (Sites 1, 2, 6A, 7)

This sampling involves retrieving the free product layer, on top of the water, from monitoring wells along with the minimum requirements presented in Section 6.1. Personnel shall wear nitrile outer and latex inner gloves for all groundwater sampling and Tyvek coveralls for incidental contact but PVC if excessive splash potential exists.

6.3.6 Water Level Measurement and Site Survey (Sites 1, 2, 6A, 7)

Personnel shall wear boot covers and nitrile inner gloves when conducting these sampling activities along with the minimum requirements presented in Section 6.1.

6.3.7 Aquifer Testing (Sites 1, 2, 6A, 7)

Personnel shall wear boot covers and nitrile inner gloves when conducting these sampling activities along with the minimum requirements presented in Section 6.1.

7.0 SITE CONTROL MEASURES

The purpose of site control is to minimize the potential spread and threat of potential contamination to onsite workers and the general public at large. In addition, this activity prepares the site for activities, by doing so it also prepares the site and onsite personnel to handle potential emergency situations.

Perimeter, zone, and site control will be accomplished through the implementation of the following control factors:

7.1 EXISTING PERIMETER AND/OR ZONE CONTROLS

- Site Preparation
- Site Map
- Site Security
- Perimeter/Zone Identification
- Site Communications
- Buddy System
- Material Safety Data Sheets
- Standard Work Practices

7.1.1 Site Preparation

In preparation for site activities, and the unexpected the FOL shall conduct preliminary planning prior to the commencement of onsite activities. These plans shall include:

- Identify access routes for each proposed work location to move equipment, resources, and emergency vehicles if necessary. This should include support facilities (i.e toilet facilities, etc.)
- Inform Base Security to ensure onsite operations will not be effected by traffic flow patterns. If so, schedule work to reduce the amount of disruption for the area.
- Construct, locate, and/or identify staging of stored materials, decontamination area, sampling/resource processing area
- Evaluate work locations and eliminate physical hazards as possible
- Locate, identify, and obtain permission for use of the telephone communications for each site task location
- Obtain and station emergency equipment as required (i.e fire extinguishers, first-aid kits,etc.)

7.1.2 Site Map

The site maps found in Section 2.0 will be used to identify access routes, evacuation routes, assembly points, telecommunications (approved for use), perimeter zones, and for traffic planning, if necessary. In addition, the map will be plotted with potential receptors (i.e. storm sewers, drains, buildings, etc.) in the event of an accidental release. This exercise will also aid in identifying potential dispersion routes. This information will be determined prior to the commencement of onsite activities, and conveyed as part of the site-specific training, and as briefing prior to moving into a new area.

7.1.3 Base Security

Restriction of general traffic in and around specified work areas will be accomplished through coordination with Base security. Restriction of unauthorized base personnel will be coordinated through the Base contact and Safety and Environmental Management Section. Security for the perimeter zones and access control points where the individual activities will take place will be the responsibility Halliburton NUS, and their subcontractors.

7.1.4 Perimeter/Zone Identification

Perimeter/Zone identification will be accomplished in a dual step approach. The first step will be the overall identification of the sampling areas utilizing maps contained in Section 2.0 of this HASP, and the maps available illustrating the proposed sampling points, well locations, and test pits. This will be used to educate field personnel the potential areas of contamination and therefore areas of restriction. As it would be impossible to secure the entire area to be sampled, a three zone delineation shall be utilized in step two of the dual stage approach.

7.1.4.1 Three Zone Delineation

A three zone approach will be used to secure activity points, control potential migration of site contaminants, and to protect the health and welfare of the site workers, base personnel, and general public.

This approach will designate the sampling point and a ten foot circumference (25 foot for test pits and drilling operations) as the Exclusion Zone, the area of known (or suspected) contamination. A ten foot circumference outside the exclusion zone shall act as the Contamination Reduction Zone, where all decontamination activities will take place. All operations conducted within these two zones shall employ extra measures of protection stipulated in this plan to be utilized in the presence of contamination. The third, and final zone is the support zone. This is a designated clean zone where no contamination is present. All materials and support for these

operations will be routed from this zone. Movement between the zones will be done through control points. All movement from the exclusion zone outward toward the support zone will require complete decontamination and approval from the field team leader or the on site health and safety representative for all equipment and personnel.

7.1.5 Site Communications

As part of the mobilization process for the individual work sites, telephone services will be identified and access to these services will be obtained. This will serve as the primary link for both internal and external communication for emergency services and resources. In addition, the alarm system shall serve as a means of communication. The alarm system at the facility has been described as a distinguishable repetitive tone. Lastly, radio communication will be maintained with the Calverton sponsor/representative should contact with the field crew be necessary.

7.1.6 Buddy System

Personnel while engaged in onsite activities will practice the "buddy system" to insure the safety of all personnel involved in this operation.

7.1.7 Material Safety Data Sheets (MSDS) Requirements

Halliburton NUS personnel will provide MSDS's for all chemicals brought on site. The MSDS's will be maintained in a central location (i.e. temporary office) and will be available for anyone to review upon request.

7.2 Ionizing Radiation

Normal background 0.01 to 0.02 mR/hr. If less than 2 mR/hr, continue investigation with caution. If greater than 2 mR/hr, evacuate site. Note: normal background is 0.005 to 0.01 mR/hr.

8.0 MEDICAL SURVEILLANCE

8.1 REQUIREMENTS FOR Halliburton NUS PERSONNEL

All Halliburton NUS personnel participating in project field activities will have had a physical examination meeting the requirements of Halliburton NUS' medical surveillance program and will be medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained in the Halliburton NUS Pittsburgh office and made available as necessary.

8.2 REQUIREMENTS FOR SUBCONTRACTORS

Subcontractors are required to obtain a certificate of their ability to perform hazardous waste site work and to wear respiratory protection. The "Subcontractor Medical Approval Form" (Figure 8-1) can be used to satisfy this requirement providing it is properly completed and signed by a licensed physician.

Subcontractors who have a company medical surveillance program meeting the requirements of paragraph (f) of OSHA 29 CFR 1910.120 can substitute Figure 8-1 with a letter, on company letterhead, containing all of the information in the example letter presented as Figure 8-2. Figures 10-1 and 8-2 can be combined into one letter.

8.3 REQUIREMENTS FOR ALL FIELD PERSONNEL

Each field team member (including subcontractors) shall be required to complete and submit a copy of Figure 8-3 (Medical Data Sheet). This shall be provided to the SSO prior to participating in site activities.

FIGURE 8-1

SUBCONTRACTOR MEDICAL APPROVAL FORM

For employees of _____
Company Name

Participant Name: _____ Date of Exam: _____

Part A

The above-named individual has:

1. Undergone a physical examination in accordance with OSHA Standard 29 CFR 1910.120, paragraph (f) and found to be medically -

- ☐ qualified to perform work at the NWIRP, Calverton work site
- ☐ not qualified to perform work at the NWIRP, Calverton work site

and,

2. Undergone a physical examination as per OSHA 29 CFR 1910.134(b)(10) and found to be medically -

- ☐ qualified to wear respiratory protection
- ☐ not qualified to wear respiratory protection

My evaluation has been based on the following information, as provided to me by the employer.

- ☐ A copy of OSHA Standard 29 CFR 1910.120 and appendices.
- ☐ A description of the employee's duties as they relate to the employee's exposures.
- ☐ A list of known/suspected contaminants and their concentrations (if known).
- ☐ A description of any personal protective equipment used or to be used.
- ☐ Information from previous medical examinations of the employee which is not readily available to the examining physician.

Part B

I, _____, have examined _____
Physician's Name (print) Participant's Name (print)
and have determined the following information:

FIGURE 8-1
SUBCONTRACTOR MEDICAL APPROVAL FORM
PAGE TWO

1. Results of the medical examination and tests (excluding finding or diagnoses unrelated to occupational exposure):

2. Any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health:

3. Recommended limitations upon the employee's assigned work:

I have informed this participant of the results of this medical examination and any medical conditions which require further examination or treatment.

Based on the information provided to me, and in view of the activities and hazard potentials involved at the _____ work site, this participant

- () may
() may not

perform his/her assigned task.

Physician's Signature _____

Address _____

Phone Number _____

NOTE: Copies of test results are maintained and available at:

Address

FIGURE 8-2

MEDICAL SURVEILLANCE LETTER

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO

XYZ CORPORATION

555 E. 5th Street

Nowheresville, Kansas 55555

Month, day, year

Mr. David Brayack

Project Manager

Halliburton NUS Corp.

661 Andersen Drive

Pittsburgh, Pennsylvania 15220

Subject: Medical Surveillance - NWIRP, Calverton

Dear Mr. Brayack:

As an officer of XYZ Corporation, I hereby state that the persons listed below participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120 entitled "Hazardous Waste Operations and Emergency Response: Final Rule." I further state that the persons listed below have had physical examinations under this program within the past 12 months and that they have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive and negative pressure respiratory protection. I also state that, to my knowledge, no person listed below has any medical restriction that would preclude him/her from working at NWIRP, Calverton.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

Figure 8-3

Subject HEALTH AND SAFETY PLANS	Number HS01	Page 64 of 64
	Revision 3	Effective Date 08/15/87

Medical Data Sheet and Field Team Review

This brief Medical Data Sheet will be completed by all onsite personnel and will be kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project _____

Name _____ Home Telephone _____

Address _____

Age _____ Height _____ Weight _____

Name of Next Kin _____

Drug or other Allergies _____

Particular Sensitivities

Do You Wear Contacts?

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals

What medications are you presently using? _____

Do you have any medical restrictions? _____

Name, Address, and Phone Number of personal physician: _____

• • • • •

I am the individual described above. I have read and understand this HASP.

Signature

Date

9.0 DECONTAMINATION

9.1 PERSONNEL DECONTAMINATION REQUIREMENTS

The decontamination of personnel and their protective clothing shall be performed in three stages. Stage 1 includes removing contamination from reusable and disposable protective clothing with a detergent/water solution and soft bristle scrub brushes. Stage 2 shall include removal of protective clothing (grossly contaminated disposable items shall be discarded into a container conspicuously marked "Potentially Contaminated Clothing". Disposable items deemed noncontaminated shall be disposed of as normal refuse on base). Stage 3 shall consist of workers washing hands and face with potable water and soap and/or leave the exclusion (or "Hot") zone. See Figure 9-1.

9.2 DECONTAMINATION OF SAMPLING TOOLS

All sampling equipment that will be leaving the site will require a thorough decontamination. This can be accomplished either by steam cleaning or by a detergent wash and potable water rinse until tools are visibly clean. Decontamination of sampling tools to prevent cross contamination of samples shall be performed in accordance with the RFI Quality Assurance Project Plan.

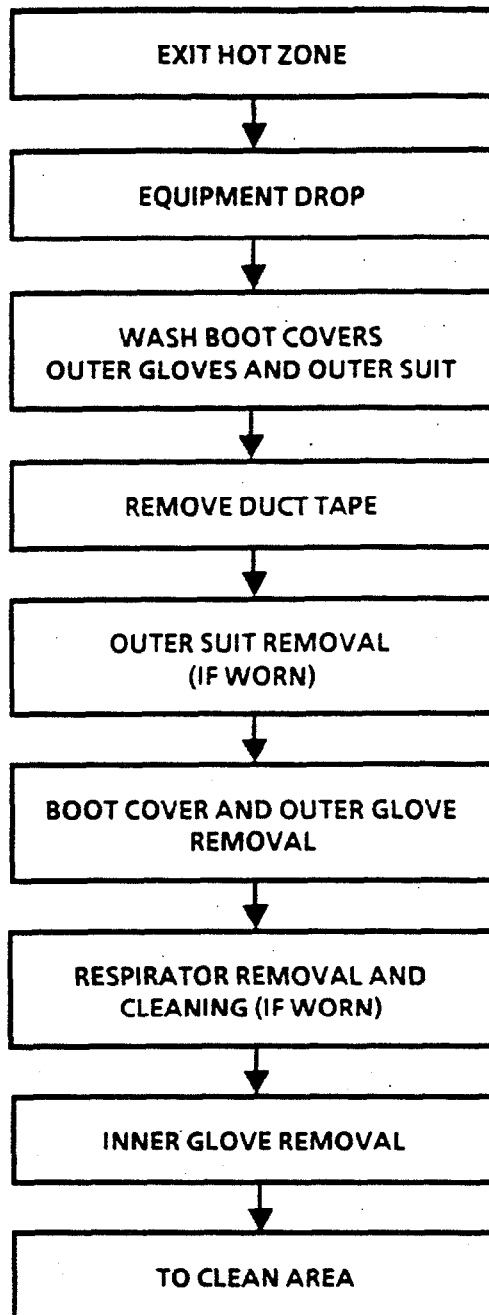
Waste fluids generated through decontamination shall be handled as described in Section 9.5. Any tools or equipment that cannot be satisfactorily decontaminated shall be treated as wastes, and be handled and disposed of accordingly.

9.3 CORING/DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION

Coring/drilling and excavation equipment will be thoroughly decontaminated as necessary to remove detectable contamination utilizing a method stipulated by the Halliburton NUS subcontractor that will not damage the equipment. All decontamination fluids shall be contained and handled as in Section 9.5.

9.4 PPE REQUIREMENTS FOR DECONTAMINATION OPERATIONS

All personnel performing decontamination activities must wear, in addition to minimal requirements, PVC coveralls, nitrile outer and inner gloves, boot covers, and taped ankle and wrist seams. When decontaminating heavy equipment (drill rigs) or anything else where a splash potential exists from high-pressure water, personnel must wear hard hats with a chemical splash shield attached to protect the eyes and face. If respirators were necessary during field activities when using the equipment to be deconned, then the same respiratory protection may be required for deconned that particular equipment. Deconned equipment will be screened with a monitoring instrument to ensure effective decon.



The sketch is for general decontamination procedures for operations at the NWIRP Calverton Site. The level of protection, concentration of chemicals (visual inspection), and other factors will determine the extent of decontamination. Decontamination procedures may have to be modified after work begins if site conditions warrant change.

FIGURE 9-1

**SKETCH OF DECONTAMINATION PROCEDURE
NWIRP CALVERTON SITE**



HALLIBURTON NUS
Environmental Corporation

9.5 DECONTAMINATION EVALUATION

The evaluation of the decontamination process shall be performed in the following manner:

- Visual Observation - Discolorations, stains, visible material, and the degradation of the article being assessed.
- Monitoring Instrumentation - Sweeping of the decontaminated article with the screening instruments described in section 5.0 will be used in conjunction with visual observation.
- Laboratory analyses - The laboratory analyses of the samples obtained from the various site locations used in conjunction with the above methods can be used for the eventual disposal of containerized PPE.

This evaluation will determine first the overall effectiveness of the process and second the disposal method to be employed with regards to PPE. Unfavorable results will require the process and procedures to be reevaluated. The action levels utilized will be any detection.

9.6 DISPOSAL OF POTENTIALLY CONTAMINATED PPE AND DECONTAMINATION OF WASTE FLUIDS

- Personnel are responsible for drumming and staging all (grossly contaminated and clothing waiting final evaluation) disposable PPE, and for labeling such containers appropriately. Questions regarding this practice should be directed to the PM.

NOTE: Clothing and equipment favorably passing the evaluation may be moved to another location for use, or disposal as refuse, relative to the purpose of the evaluation.

- All decontamination waste fluids will be sent to the onsite wastewater treatment plant. Direction can be taken from the client contact.
- Drill cuttings will be drummed, labeled, and disposed of properly. Questions regarding this procedure should be directed to the Project Manager.

10.0 TRAINING REQUIREMENTS

This section describes the minimum requirements for initial, refresher, supervisory, and site-specific training.

10.1 INTRODUCTORY AND REFRESHER TRAINING

10.1.1 Requirements for Halliburton NUS Personnel

All Halliburton NUS personnel must complete 40 hours of introductory hazardous waste site training prior to performing work at NWIRP Calverton. Additionally, Halliburton NUS personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. Those individuals functioning in the Supervisory capacity will also be required to show documentation of the successful completion of a Supervisory course in accordance with OSHA 29 CFR 1910. 120 (e).

HALLIBURTON NUS HEALTH AND SAFETY TRAINING

Name	Type(s) of Training Received	Date(s) Training Received
David Brayack	Initial 40-Hour Health and Safety Training	05/88
	8-Hour Refresher	12/92
	8-Hour Supervisory Training	11/89
Mark Mengel	Initial 40-Hour Health and Safety Training	01/83
	8-Hour Refresher Training	09/92
	8-Hour Supervisory Training	03/88

Documentation of Halliburton NUS introductory and refresher training will be maintained at the project. Copies of certificates or other official documentation will be used to fulfill this requirement.

10.1.2 Requirements for Subcontractors

All Halliburton NUS subcontractor personnel must have completed introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e) and 8 hours of refresher training meeting the requirements of 29 CFR 1910.120(e)(8) prior to performing field work NWIRP, Calverton. Halliburton NUS subcontractors must certify that each employee has had such training by sending Halliburton NUS a letter, on company letterhead, containing the information in the example letter provided as Figure 10-1. Figures 10-1 and 8-2 can be combined into one letter.

FIGURE 10-1

OSHA TRAINING CERTIFICATION

The following statements must be typed on company letterhead and signed by an officer of the company:

LOGO

XYZ CORPORATION

555 E. 5th Street

Nowheresville, Kansas 55555

Month, day, year

Mr. David Brayack

Project Manager

Halliburton NUS Corp.

661 Andersen Drive

Pittsburgh, Pennsylvania 15220

Subject: Hazardous Waste Site Training - NWIRP, Calverton

Dear Mr. Brayack:

The employees listed below have had introductory hazardous waste site training or equivalent work experience as required by 29 CFR 1910.120(e). In addition, those employees listed below who have received their introductory training more than 12 months ago have also received 8 hours of refresher training in accordance with 29 CFR 1910.120 (e)(8) within the past 12 months.

LIST FULL NAMES OF EMPLOYEES AND THEIR SOCIAL SECURITY NUMBERS HERE

Should you have any questions, please contact me at (555) 555-5555.

Sincerely,

(Name of Company Officer)

Halliburton NUS will provide site-specific training to all Halliburton NUS employees and subcontractor personnel who will perform work at this project. Site-specific training will include:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of the health and safety plan and addendum
- Emergency response procedures (evacuation and assembly points)
- Review the contents of relevant Material Safety Data Sheets

10.2.1

Site-Specific Training Documentation

Halliburton NUS and subcontractor personnel will be required to sign a statement indicating receipt of site-specific training and understanding of site hazards and control measures. Figure 10-2 will be used to document site-specific training.

FIGURE 10-2

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing investigation activities at NWIRP, Calverton and that I have received site-specific training which included the elements presented below:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- The contents of the health and safety plan
- Emergency response procedures (evacuation and assembly points)
- Review contents of relevant Material Safety Data Sheets

I further state that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction.

NAME	SIGNATURE	DATE

11.0 EMERGENCY RESPONSE PLAN

In the event of onsite emergencies (i.e. fires, significant spills or releases, etc.) personnel shall be immediately evacuated to a safe place of refuge and notify the appropriate onsite response agencies (Figure 13-1). In addition notification shall include Halliburton NUS Project Manager (David Brayack), and the CLEAN Health and Safety Manager (Matthew M. Soltis). In view of this approach, this section of the Health and Safety Plan is provided to be in compliance with OSHA Standard 29 CFR 1910.38(a) [as permitted by OSHA 29 CFR 1910.120(l)(1)(ii)].

11.1 PERSONNEL ROLES AND LINES OF AUTHORITY

The Halliburton NUS Field Operations Leader (FOL) shall be responsible for the overall direction and implementation of this ERP, and for overall coordination of any emergency response actions.

The Halliburton NUS Site Safety Officer (SSO) shall serve as assistant and alternate to the FOL and shall provide health and safety input during emergencies.

As part of the preplanning efforts the FOL or SSO will meet with the designated onsite emergency response coordinator with information concerning work activities and associated hazards. All site personnel will be required to follow this procedure and will rely on GAC crash team fire brigade or the spill response team to handle any and all emergencies should they occur during onsite activities.

The FOL or his alternate is responsible for notifying the appropriate outside emergency assistance, as needed, in accordance with Section 11.0 (Figure 11-1).

11.2 EMERGENCY ESCAPE

Within each area of proposed site activities the FOL or SSO will select a place of refuge and an alternate location along with evacuation routes prior to the initiation of site activities. Consideration for refuge selection should include but not be limited to chemical/physical properties, wind direction, topography, and fire and explosion potential. If site evacuation becomes necessary, personnel shall immediately take the most direct route to the selected locations where they will await further instruction from the Halliburton NUS Field Operations Leader.

11.0 EMERGENCY RESPONSE PLAN

In the event of onsite emergencies (i.e. fires, significant spills or releases, etc.) personnel shall be immediately evacuated to a safe place of refuge and notify the appropriate onsite response agencies (Figure 11-1). In addition notification shall include Halliburton NUS Project Manager (David Brayack), and the CLEAN Health and Safety Manager (Matthew M. Soltis). In view of this approach, this section of the Health and Safety Plan is provided to be in compliance with OSHA Standard 29 CFR 1910.38(a) [as permitted by OSHA 29 CFR 1910.120(l)(1)(ii)].

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The Halliburton NUS Site Safety Officer (SSO) shall serve as assistant and alternate to the FOL and shall provide health and safety input during emergencies.

As part of the preplanning efforts the FOL or SSO will meet with the designated onsite emergency response coordinator with information concerning work activities and associated hazards. All site personnel will be required to follow this procedure and will rely on GAC Crash Team, Fire Brigade, or the Spill Response Team to handle any and all emergencies should they occur during onsite activities. These activities under their guidance would proceed in accordance with Attachment D-III.

The response teams locations and accessibility are shown on Figure 2-2.

The FOL or his alternate is responsible for notifying the appropriate outside emergency assistance, as needed, in accordance with Section 11.0 (Figure 11-1).

11.2 EMERGENCY ESCAPE

Within each area of proposed site activities the FOL or SSO will select a place of refuge and an alternate location along with evacuation routes prior to the initiation of site activities. Consideration for refuge selection should include but not be limited to chemical/physical properties, wind direction, topography, and fire and explosion potential. If site evacuation becomes necessary, personnel shall immediately take the most direct route to the selected locations where they will await further instruction from the Halliburton NUS Field Operations Leader.

FIGURE 11-1
EMERGENCY INFORMATION

Police Riverhead Police (516)797-4500	Base Security (516)953-6611	On Base Emergency Access Extension 3333
Fire Manorville Fire Department (516)924-5252	Base Security (516)953-6611	On Base Emergency Access Extension 3333
Emergency	Base Security (516)953-6611	On Base Emergency Access Extension 3333
Ambulance	Base Security (516)953-6611	On Base Emergency Access Extension 3333
Hospital	Central Suffolk (Riverhead)	(516)548-6000
Poison Control		1-800-962-1250
Base Contact	Debra Felton M. Simonson	(215)535-0567 (516)575-9952
Nearest phone		
Halliburton NUS Project Manager	David Brayack	(412)921-8375 1-800-245-2730
Halliburton NUS Health and Safety Officer	Thomas M. Dickson	(412)921-8457 1-800-245-2730
CLEAN Health and Safety Manager	Matthew M. Soltis	(412)921-8912 1-800-245-2730

*This telephone number is a dispatch service (Fire center at Yaphank) responsible for sounding the fire alarm.
NOTE: All emergency notification will be made through Base security.

Hospital Directions:

Proceed to the north gate turn right traveling east on Route 25 (Middle County Road). Route 25 turns into Route 58. Proceed to traffic circle. The hospital is on the left. The hospital is approximately 10 minutes away from the site.

11.3 MAINTENANCE OF CRITICAL OPERATIONS

It is not anticipated that any personnel will need to remain at their worksite to maintain any critical operations. If this condition should change, the Health and Safety Officer shall identify the personnel and their responsibilities in this regard and amend this Plan accordingly. Any such modifications must be communicated to the Health and Safety Manager for concurrence.

11.4 PERSONNEL ACCOUNTING

In the event of an emergency evacuation, personnel shall immediately report to the designated refuge location, and remain there. The Site Safety officer, assisted by the Field Operations Leader, shall conduct a roll call (using the site log book) to account for all personnel to ensure that a total worksite evacuation has taken place. If the roll call identifies that any personnel are not accounted for, this information shall be immediately communicated to the off-site emergency response agency upon their arrival. This information is to be supplemented with any additional information available which could be of assistance in conducting rescue operations (i.e., last known location of the missing personnel, etc.). Site personnel are not authorized to participate in emergency response/rescue operations.

11.5 RESCUE AND MEDICAL DUTIES

Site personnel are not authorized to participate in rescue activities. However, any personnel present who are trained to perform emergency first aid activities may perform these functions, if needed, after rescue or evacuation operations have been completed.

11.6 EMERGENCY REPORTING

Emergency reporting functions shall be the responsibility of the Field Operations Leader. Figure 11-1 identifies the agency to be contacted. The Field Operations leader will become thoroughly familiar with this Plan prior to initiation of any site activities. For each area of operation the nearest phone will be located and permission for its use will be obtained for purposes of emergency services notification.

In the event that an emergency incident occurs and onsite response assistance is necessary, the Field Operations Leader or Site Safety Officer shall contact Base Security and communicate the following information:

- Name and location
- Nature of the incident (fire, spill, chemical exposure, physical injury, etc.)
- Number of injuries and type(s) of injury (injuries)
- Quantity and type of material spilled (if applicable)
- Possible contaminants which may be encountered in response efforts.

Base security will notify the appropriate onsite services as described in Attachment D-III of Grumann Emergency Response. A copy of this plan will be provided to the Grumann Aerospace Corporation (GAC) Crash Crew and Spill Response Team both as a professional courtesy and as a means of notification of potential hazards associated with proposed site activities with regard to responding.

11.7 SITE EMERGENCY ALARM SYSTEM

All workers will be in close proximity to each other, therefore, an emergency alarm system for onsite activity is not required. The main facility alarm system is a repetitive tone. Activation of the alarm or two-way radio communication to the plant representative or FOL will require activation of the emergency response procedures.

11.8 INCIDENT FOLLOW-UP

On receiving a report of an incident (or near incident) occurrence the FOL and/or SSO shall immediately investigate the circumstances and shall investigate the recommendations to prevent the recurrence. As part of the notification procedures, the PM or HSM may wish to participate in the investigation.

11.9 INCIDENT REPORT

Details of the incident (or near incident) shall be documented within 24 hours of the occurrence. This documentation will be distributed to the Halliburton NUS administrative contact for inclusion into the OSHA Form 101 and 200 log, PM, HSM, and NWIRP, Calverton.

12.0 STANDARD WORK PRACTICES

All site investigation activities will follow the appropriate Health and Safety Standard Operating Procedures.

The following safe working procedures are to be applied in addition to the Health and Safety Standard Operating Procedures:

- Eating, drinking, chewing gum or tobacco, taking medication, and smoking are prohibited in the exclusion or decontamination zones, or any location where there is a possibility for contact with site contaminants exists.
- Upon leaving the exclusion zone, hands and face must be thoroughly washed. Any protective outer clothing is to be decontaminated and removed as specified in this HASP, and left at a designated area prior to entering the clean area.
- Contact with potentially-contaminated substances must be avoided. Contact with the ground or with contaminated equipment must also be avoided. Monitoring equipment must not be placed on potentially contaminated surfaces.
- No facial hair, which interferes with a satisfactory fit of the mask-to-face seal, is permitted on personnel required to wear respiratory protective equipment.
- All personnel must procure a site-specific Health and Safety Plan from the project Health and Safety Officer prior to commencing work on site. All site personnel must read and understand all components of this HASP. Additionally, a Site Safety Follow-up report (see Appendix A) must be filed with each trip report following completion of a task.
- All personnel must satisfy medical monitoring procedures.
- No flames or open fires will be permitted on site.
- No drilling within 20 feet in any direction of overhead power lines will be permitted. The locations of all underground utilities must be identified, documented, and marked prior to initiating any subsurface activities.
- All personnel must be aware of and follow the action levels presented in this HASP for upgrading respiratory protection.

- Any new analytical data must be promptly conveyed via telephone to the project Health and Safety Officer by the lab technician or Field Team Leader.
- Personnel must develop hand signals with the driller.
- A copy of the attached OSHA poster must be prominently posted at each site.
- All drill rigs and other machinery with exposed moving parts must be equipped with an operational emergency stop device. Drillers and geologists must be aware of the location of this device. This device must be tested prior to job initiation, and periodically thereafter. The driller and helper shall not simultaneously handle moving augers or flights unless there is a standby person to activate the emergency stop.
- The driller must never leave the controls while the tools are rotating unless all personnel are clear of the rotating equipment.
- A long handled shovel or equivalent must be used to clear drill cuttings away from the hole and from rotating tools. Hands and/or feet are not to be used for this purpose.
- A remote sampling device must be used to sample drill cuttings if the tools are rotating. Samplers must not reach into or near the rotating equipment. If personnel must work near any tools which could rotate, the driller must shut down the rig prior to initiating such work.
- Drillers, helpers and samplers must secure all loose clothing when in the vicinity of drilling operations.
- Only equipment which has been approved by the manufacturer may be used in conjunction with site equipment and specifically to attach sections of drilling tools together. Pins that protrude from augers shall not be allowed.
- No person shall climb the drill mast while tools are rotating.
- No person shall climb the drill mast without the use of ANSI-approved fall protection (i.e., approved belts, lanyards and a fall protection slide rail) or portable ladder which meets the requirements of OSHA standards.
- No person, under any circumstances, shall enter a test pit. Personnel must use remote samplers to collect samples from test pits or collect the samples from the backhoe bucket. The latter is recommended.

- No sampling of drums is to occur during test pitting operations without prior approval and written procedures from the Project Manager and the OHSS.
- Personnel must not lean over test pits.
- Personnel must stand upwind from the test pits and away from the reach of the backhoe, tires, and outrigger.
- Personnel must stand a minimum of 2 feet from the edge of any test pit. Pits must be sloped at a ratio of 2:1 at the sides where personnel will stand or where equipment will be positioned to prevent cave-in. A lesser slope may be considered acceptable by OSHA 29 CFR 1926.651.
- No open pits will be left unattended, under any circumstances, unless adequate precautions are taken to prevent access.
- The backhoe operator shall not undermine the excavation.
- The Site Safety Officer (SSO) shall frequently inspect the test pits for slide or cave-in potential.
- "All" compressed gas cylinders (empty or full) must be stored and used in an upright position, properly secured and protected from damage.
- The site safety officer must make an entry into the Health and Safety logbook each day, including monitoring instrument calibration logs.
- A copy of the appropriate Health and Safety Standard Operating Procedures must be present on site.
- Appropriate training and medical monitoring records must be maintained on site for all site personnel including subcontractors.
- All site personnel including subcontractors must complete a medical data sheet, to be maintained on site.
- Site personnel must immediately notify NUS Health Sciences (the HSM or SSO) of all incidents for OSHA record keeping purposes.

- If personnel note any warning properties of chemicals (irritation, odors, symptoms, etc.) or even remotely suspect the occurrence of exposure, they must immediately notify the SSO for further direction.
- Site personnel are not to undertake any activity which would be considered a confined-space entry without first being trained in the proper procedures by the SSO, and obtaining a Confined Space/Limited Egress Permit.
- Areas must be designated for chemical storage. Acids, bases and flammables shall all be stored separately. Storage areas must be labeled as to the contents within the storage area.

The SSO must make an entry into the site health and safety logbook at least daily, to include:

- Weather conditions
- Site Personnel
- New arrivals and "clearance for site work"
- Air monitoring data summary
- Indications of inhalation exposure
- PPE used per task
- Deviations from HASP
- Inspection and cleaning of respiratory equipment
- General H&S problems/corrective actions

13.0 CONFINED SPACE ENTRY (CSE) PROCEDURES

There are no confined space entry operations anticipated for this project; therefore, this section is not applicable.

14.0 SPILL CONTAINMENT PROGRAM

14.1 SPILL RESPONSE PROCEDURES

In case of an accidental spill, notify the onsite security at (516)953-6611. This department can contact a spill response truck which responds to any accidental spills at the NWIRP Calverton facility. The FOL shall activate the Emergency Response Plan specified in this HASP, as appropriate, with assistance from the SSO.

APPENDIX A

**SITE HEALTH AND SAFETY
FOLLOW-UP REPORT**

SITE HEALTH AND SAFETY FOLLOW-UP REPORT

This section must be filled out and returned to the Site Health and Safety Officer after the conclusion of each site visit.

Person responsible for follow-up report: _____

Actual date(s) of work: _____

Actual Project Team:

HALLIBURTON NUS Personnel:	Discipline/Tasks:

Non-HALLIBURTON NUS Personnel/Application:	

PERSONAL PROTECTIVE EQUIPMENT

● Level of Respiratory Protection Used	Activity Performed

● Field Dress	Activity

REQUEST FOR HASP MODIFICATION
(To be Completed for Each Field Change in Plan)

Describe, in detail, requested changes to the Health and Safety Plan:

Reason for changes:

Follow-up, Review and Evaluation Prepared by: _____ Date _____

Discipline _____

Approved by: Site Manager _____ Date _____

Site Health and Safety Officer _____ Date _____

Approved by: Office Health & Safety Supervisor _____ Date _____

GENERAL SAFETY

Were any health or safety problems encountered while on site?

Explain: _____

INCIDENT REPORT INFORMATION

Did any team member report:

- Chemical exposure
- Illness, discomfort, or unusual symptoms
- Environmental problems (heat, cold, etc.)
- Injury

Yes

No

Explain:

Was an Employee Incident Report Completed?

 Yes

 No

Evaluation of Site Health and Safety Plan

Was the Health and Safety Plan adequate?

 yes

 no

What changes would you recommend?

FIRST AID SUPPLIES USAGE FORM

[illegible]

Please submit this information as soon as possible to to the HALLIBURTON NUS/Environmental Technologies Group Equipment Manager for first-aid supply replenishment. Telephone number (412) 262-4583

SCBA LOG

Site: _____

Location: _____

Dates of Investigation: _____

User	Date of Use	SCBA No.	Satisfactory Check-Out (Yes/No - Initials)	Date Cleaned

SCBA Performance Comments:

Site Manager

Date

Return to HSO at Completion of Activity

**AIR PURIFYING
RESPIRATOR LOG**

Type of Respirator: _____

Site: _____

Location: _____

Dates of Investigation: _____

User	Date of Use	Cleaned and Inspected Prior To Use (Initials)	Cartridges Changed Prior to Use (Yes/No)	Total Hours On Cartridge

Site Manager

Date

Return to HSO at Completion of Activity

EMPLOYEE INCIDENT REPORT

Report No. _____
Project No. _____
Site: _____
Location: _____
Date of Report: _____ Preparer's Name: _____
Name and Address of Injured: _____ SSN: _____ Age: _____
Sex: _____
Years of Service: _____ Time of Present Job: _____ Title/Classification: _____
Division/Department: _____ Date of Incident: _____ Time: _____
Incident Category: _____ Motor Vehicle _____ Property Damage _____ Fire
Chemical Exposure _____ Near-Miss _____ Other
Severity of Injury or Illness: _____ Nondisabling _____ Disabling
Medical Treatment _____ Fatality
Amount of Damage: \$ _____ Property Damage: _____
Estimated Number of Days Away from Job: _____
Nature of Injury or Illness: _____

Classification of Injury:

_____ Fractures	_____ Heat Burns	_____ Cold Exposure
_____ Dislocations	_____ Chemical Burns	_____ Frostbite
_____ Sprains	_____ Radiation Burns	_____ Heat Stroke
_____ Abrasions	_____ Bruises	_____ Heat Exhaustion
_____ Lacerations	_____ Blisters	_____ Concussion
_____ Punctures	_____ Toxic Respiratory Exposure	_____ Faint/Dizziness
_____ Bites	_____ Toxic Ingestion	_____ Toxic Respiratory
_____ Respiratory Allergy		_____ Dermal Allergy

Part of Body Affected: _____
Degree of Disability: _____
Date Medical Care was Received: _____

Where Medical Care was Received: _____
Address (if off site): _____

Incident Location

Causative agent most directly related to accident (object, substance, material, machinery, equipment, conditions): _____

Was weather a factor? _____

Unsafe mechanical/physical/environmental condition at time of accident (Be specific):

Unsafe act by injured and/or others contributing to the accident (Be specific, must be answered):

Personal factors (improper attitude, lack of knowledge or skill, slow reaction, fatigue):

Level of personal protection equipment required in Site Safety Plan:

Modifications: _____

Was injured using required equipment: _____

If not, how did actual equipment use differ from plan? _____

What can be done to prevent a recurrence of this type of accident (modification of machine; mechanical guards; correct environment; training)?

Detailed narrative description (how did accident occur, why; objects, equipment tools used, circumstances, assigned duties). Be specific:

(Use back of sheet, as required)

Witnesses to accident: _____

Signature of Preparer _____

Signature of Site Manager _____

Department Appraisal and Recommendation

In your opinion, what actions or equipment contributed to this accident?

Your recommendation:

Date: _____ Signature of Department Manager _____

FOR HEALTH AND SAFETY USE ONLY

Temporary total _____

Death or permanent total _____

Started losing time _____

Returned to work _____

Time charge _____

Compensation \$ _____

Other \$ _____

Permanent partial _____

Part of body _____

Percent loss or _____

loss of use _____

Time charge _____

Medical \$ _____

Total \$ _____

Name and Address _____

of Hospital _____

Name and Address _____

of Physician _____

cc: OHSS

Administrative Manager

MHS

Medical Consultant

INCIDENT FOLLOW-UP REPORT

Date of Incident: _____

Name: _____

Employee No. _____

Site: _____

Brief description of incident: _____

Outcome of incident: _____

Physician's recommendations: _____

Date returned to work: _____

ATTACH ANY ADDITIONAL INFORMATION TO THIS FORM

cc: OHSS
Administrative Manager
MHS
Medical Consultant

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct periodic inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each

citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to \$1,000 for each serious violation and for additional penalties of up to \$1,000 for each nonserious violation. Penalties of up to \$1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to \$10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than \$10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following locations:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California
Seattle, Washington

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1988 (Revised)
OSHA 2203

Ann McLaughlin

Ann McLaughlin, Secretary of Labor

U.S. Department of Labor
Occupational Safety and Health Administration



Under provisions of Title 29, Code of Federal Regulations, Part 1903.2(a)(1) employers must post this notice (or a facsimile) in a conspicuous place where notices to employees are customarily posted.

JPO : 1988 O - 219-667

APPENDIX B

HEARING CONSERVATION PROGRAM

APPENDIX B

HEALTH AND SAFETY STANDARD OPERATING PROCEDURES

Number
HS2.13

Page
1 of 3

Effective Date
08/01/90

Revision
1

Applicability
All Project Activities

Prepared
G. Beswick, CIH

Approved
R. E. Stecik, Jr.

Subject

HEARING CONSERVATION PROGRAM

CONTENTS

- 1.0 PURPOSE
- 2.0 SCOPE OF COVERAGE
- 3.0 DEFINITIONS
- 4.0 RESPONSIBILITIES
- 5.0 PROCEDURES
 - 5.1 AVAILABILITY
 - 5.1.1 Short Duration Projects
 - 5.1.2 Long Duration Project/Remediation Projects

ATTACHMENTS

Form HS2.13-1

1.0 PURPOSE

To establish the requirements of a minimally acceptable hearing conservation program in accordance with OSHA 29 CFR 1910.95.

2.0 SCOPE OF COVERAGE

This procedure covers all ARCS III projects where noise exposures may equal or exceed an 8-hour time-weighted average sound level of 85 decibels measured on the "A" scale (slow response).

3.0 DEFINITIONS

OSHA - Occupational Safety and Health Administration

OHSS - Office Health and Safety Supervisor

HSSO - Health and Safety Site Officer

HSO - Health and Safety Officer

dBA - Decibels on the "A" weighted scale

4.0 RESPONSIBILITIES

PM - Is responsible for the development and implementation of a written hearing conservation program, as required by this procedure, for the projects under his/her control.

FTL - Is responsible for field implementation of the program.

HSSO - Is responsible for providing technical assistance to the FTL for field implementation of the program and to audit compliance with the program.

OHSS - Is responsible for providing technical expertise in the area of program development, at the request of the PM.

HSO - Is responsible for auditing the overall compliance with the procedure.

5.0 PROCEDURES

The written program required as part of this procedure must include all elements specified by OSHA 29 CFR 1910.95.

5.1 AVAILABILITY

The written program must be available on-site and must be available for review by all site employees, their representatives or OSHA inspectors.

5.1.1 Short Duration Projects

For investigation projects, where each field task is scheduled for less than 1 month, a general hearing conservation program developed for corporate use will satisfy the requirements of this procedure.

5.1.2 Long Duration Project/Remediation Projects

Any investigation project where a field task is scheduled for greater than 1 month in duration and/or any remediation project must have a completed form HS2.13-1 or equivalent on-site. This form is designed to allow the OHSS and HSSO develop a hearing conservation program which is specific to the site.

SITE-SPECIFIC HEARING CONSERVATION PROGRAM

1.0 MONITORING

Noise monitoring will be conducted in accordance with OSHA 29 CFR 1910.95 by:

Name/Title

Noise monitoring will consist of (check all that apply):

- _____ Sound level meter survey
_____ Noise dosimeter monitoring

The specific instrument to be used is _____
Make/Model

The monitoring devices will be calibrated at a frequency of _____ and
documented in the _____.

The monitoring strategy is as follows: (List all equipment on site which may produce sound pressure levels above 80 dBA and an explanation of the strategy to document actual exposures.)

All monitoring will be documented utilizing the format illustrated following Section 7.0 (attach form developed for the specific site). These forms will be maintained in accordance with Section 7.0 of this program.

Monitoring will be repeated at a frequency of _____ and anytime the following changes occur:

2.0 EMPLOYEE NOTIFICATION

All site employees exposed above 85 dBA as an 8-hour time-weighted average (TWA) will be notified of the results of the monitoring by _____

Name/Title

at an interval not to exceed _____ after the monitoring has been completed.

Notification shall be (check all that apply):

_____ Verbal

_____ Written

Notifications shall be documented in the health and safety logbook with appropriate signatures of employees notified.

3.0 OBSERVATION OF MONITORING

Prior to noise monitoring, all employees affected by the monitoring or a designated representative shall be given the opportunity to observe the monitoring. This will be accomplished by:

4.0 AUDIOMETRIC TESTING PROGRAM AND REQUIREMENTS

ARCS III personnel who perform field activities are required to participate in the HALLIBURTON NUS medical monitoring program which includes an audiometric test program meeting the requirements of OSHA 29 CFR 1910.95. Additionally, any subcontractors performing work on HALLIBURTON NUS projects who will be exposed to noise levels exceeding 85 dBA will be required to provide

documentation that they participate in an audiometric testing program which meets the requirements of 29 CFR 1910.95. Documentation of participation in the testing program will be maintained by _____ and will be located at _____

5.0 HEARING PROTECTORS AND ESTIMATING ATTENUATION

A selection of suitable hearing protectors will be made available to all employees who are expected to have 8-hour TWA noise exposures above 85 dBA. The types anticipated to be available include:

_____	Attenuation	_____
_____	Attenuation	_____
_____	Attenuation	_____

Hearing protector attenuation will be evaluated by _____ for specific noise environments according to the following method prior to determining their suitability for use: _____

The following site personnel will be required to wear hearing protectors during specific activities as determined in accordance with 29 CFR 1910.95 and the results of site-specific monitoring conducted according to Section 1.0 of this program. (This section can be completed after monitoring, if necessary.)

Name	Activity	Type of Protection Required

Upon initial distribution to site workers, hearing protectors will be properly fitted by _____ and a record of the size and type of protector will be recorded in the PPE form found in HALLIBURTON NUS SOP No. HS2.11-1.

Training in the use and care of hearing protectors shall be conducted by _____ during the initial site-specific health and safety training as part of the PPE training required by HALLIBURTON NUS SOP No. HS2.11-1. The contents of the training shall be in accordance with 29 CFR 1910.95.

Hearing protectors will be distributed by _____ from the storage location at the _____.

6.0 ACCESS TO INFORMATION AND TRAINING MATERIALS

All information required by 29 CFR 1910.95 to be made available to the employees will be posted by _____ at the _____
Name/Title

Attached is a copy of the OSHA standard 29 CFR 1910.95. This will be posted onsite by _____.

7.0 RECORDKEEPING

All records required by 29 CFR 1910.95 shall be completed by _____ and maintained at the _____ and placed on permanent file at the _____, for the minimum duration required by the standard.

Employees can access these records by contacting _____
Name/Title

All records required by this section will be transferred to any employees successive employer if _____ ceases to do business.
Company Name

APPENDIX C

RESPIRATORY PROTECTION PROGRAM

APPENDIX C	HEALTH AND SAFETY STANDARD OPERATING PROCEDURES	Number HS2.10	Page 1 of 4
		Effective Date 08/01/90	Revision 1
		Applicability All Project Activities	
		Prepared G. Beswick, CIH	
Subject RESPIRATORY PROTECTION PROGRAM		Approved R. E. Stecik, Jr.	

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- 1.0 PURPOSE
- 2.0 SCOPE
- 3.0 DEFINITIONS
- 4.0 RESPONSIBILITIES
- 5.0 PROCEDURES
 - 5.1 Availability
 - 5.1.1 Short Duration Projects
 - 5.1.2 Long Duration Project/Remediation Projects

ATTACHMENTS

HS2.10-1 Site-Specific Respiratory Protection Program

1.0 PURPOSE

To establish the requirements for a minimally acceptable respiratory protection program in accordance with OSHA 29 CFR 1910.134.

2.0 SCOPE

This procedure is applicable to all HALLIBURTON NUS field activities where respiratory protective equipment is used and/or available on-site.

3.0 DEFINITIONS

- PM - Project Manager.
- FTL - Field Team Leader.
- QHSS - Office Health and Safety Supervisor.
- HSSO - Health and Safety Site Officer.
- HSO - Health and Safety Officer.
- SOPS - Standard Operating Procedure.
- OSHA - Occupational Safety and Health Administration

Action Level - A pre-established reading on any monitoring instrument which requires an upgrade, downgrade or reevaluation of respiratory protection.

Oxygen Deficient Atmosphere - Any work area atmosphere which contains less than 19.5 percent oxygen by volume.

Toxic Environment - Any work area atmosphere which has an airborne concentration of greater than 1/2 the current TLV, PEL, REL, or other accepted safe exposure level. Additionally, any work area which contains measurable concentrations of unknown contaminants will be considered a toxic environment.

SCBA - Self-Contained Breathing Apparatus.

APR - Air-Purifying Respirators.

RESPIRATORY PROTECTION
PROGRAM

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TLV - Threshold Limit Value as defined by the American Conference of Governmental Industrial Hygienists (ACGIH).

PEL - Permissible Exposure Limit as defined by the Occupational Safety and Health Administration (OSHA).

REL - Recommended Exposure Limit as defined by the National Institute for Occupational Safety and Health (NIOSH).

4.0 RESPONSIBILITIES

PM - Is responsible for the development and implementation of a written respiratory protection program, as required by this procedure, for the projects under his/her control.

FTL - Is responsible for field implementation of the program.

HSSO - Is responsible for providing technical assistance to the FTL for field implementation of the program and to audit compliance with the program.

OHSS - Is responsible for providing technical expertise in the area of program development, at the request of the PM.

HSO - Is responsible for auditing the overall compliance with this procedure.

5.0 PROCEDURES

The written program required as part of this procedure must include all elements specified by OSHA 29 CFR 1910.134(b) and must be consistent with the site-specific Health and Safety Plan.

5.1 AVAILABILITY

The written program must be available on-site and must be available for review by all site employees, their representatives or OSHA inspectors.

RESPIRATORY PROTECTION
PROGRAM

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5.1.1 Short Duration Projects

For investigation projects where each site task is scheduled for less than one month, a general respiratory protection program developed for corporate use will be sufficient.

5.1.2 Long Duration Project/Remediation Projects

Any investigation project where a site task is scheduled for greater than one month in duration and/or any remediation project must have a completed form HALLIBURTON NUS SOP No. HS2.10-1 or equivalent on site. This form is designed to allow the OHSS and HSSO to develop a respiratory protection program which is specific to the site.

HS2.10-1
SITE-SPECIFIC RESPIRATORY PROTECTION PROGRAM
FOR THE _____ SITE

1.0 SELECTION OF RESPIRATORY PROTECTION

All respiratory protection used by HALLIBURTON NUS personnel must be selected according to HALLIBURTON NUS SOP No. HS2.02. In order to simplify this procedure for field implementation, the following action levels have been determined for this project:

Activity/Location	Action Level/Monitoring Equipment	Required Protection (Be Specific)

2.0 USE OF RESPIRATORY PROTECTION

Based on the site-specific chemical hazards and the anticipated site activities, the following respiratory protection is anticipated to be used at this project.

Activity	Respiratory Protection Anticipated

- Respiratory protection utilized to prevent exposures to toxic chemicals must only be used when accepted engineering controls are not feasible. Administrative controls (i.e. worker rotation) are not considered an accepted control measure to reduce personnel exposures on hazardous waste sites.
- Only approved respiratory protective equipment which has been properly selected for the job (HALLIBURTON NUS SOP No. HS2.02) shall be used by HALLIBURTON NUS personnel.
- In areas where an employee, because of a failure of a respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional person shall be present. Communications (voice, visual or signal line) shall be maintained between all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and he/she will have the necessary rescue equipment to assist the others in case of emergency.
- All personnel on-site must be properly fit-tested (HALLIBURTON NUS SOP No. HS2.02) for each type of equipment available on-site. The personnel qualified to perform this

testing are _____ The records of all fit-tests for site personnel are maintained by _____ and can be reviewed at _____

- All personnel on-site must be trained in the proper use of each type of respiratory protective equipment available. The following are qualified to conduct this training: _____. The training for each type of equipment must be commensurate with HALLIBURTON NUS SOP No. HS2.04 for SCBA and HS2.06 for APR. Records of this training are maintained by _____ and may be reviewed at _____.
- Respirators shall not be worn when conditions exist which prevent a good face-to-facepiece seal. These conditions include, but are not limited to, the growth of a beard on sideburns, a skull cap which projects under the facepiece, or the use of regular corrective glasses because the temple bars prohibit a proper seal. Also, the absence of one or both dentures can seriously affect the fit of any respiratory protection.
- Workers shall only use the respiratory protective equipment which has been assigned to them. Assignment of respiratory equipment will be conducted by _____ in the following manner _____

- Contact lenses shall not be worn while using respiratory protection.
- All individuals required to use respiratory protection must successfully pass a physical examination and receive written approval from the examining physician to use both positive and negative pressure respiratory protection. The written approvals for all site personnel are maintained by _____ and may be reviewed at _____.
- The actual use of all respiratory protective equipment shall conform to the manufacturer's operating instructions and training provided to the employee. A copy of all operating instructions for each type of equipment is maintained by _____ and may be reviewed at _____.

- Use of SCBA and APR will be documented by _____ using HALLIBURTON NUS SOP No. HS2.09 Attachment A (SCBA) and Attachment B (APR). These logs will be kept current on a daily basis and can be reviewed at _____.
- Respirator Cleaning - All Respirators must be cleaned and disinfected at a frequency necessary to insure that the proper protection is provided to the wearer. Those used by more than one worker must be cleaned and disinfected after each use.

In order to accomplish this task a respiratory cleaning station has been set up at _____. This station includes the following items to assist in the cleaning process: _____

The following instructions will be posted at the respirator cleaning station to ensure adequate cleaning and disinfection: _____

Based on project logistics, respiratory protection will be cleaned and disinfected by _____ . The following schedule for cleaning and disinfection will be followed:

Equipment	Cleaning Schedule	Disinfection Schedule

3.0 RESPIRATOR INSPECTION

All respiratory protection equipment used on a routine basis must be inspected during cleaning. Worn or deteriorated parts must be immediately replaced or the unit tagged and taken out of service. Respirators for emergency use must be inspected at least every 30 days and after each use. Additionally, all respiratory protective equipment must be inspected by the HSSO, regardless of use, and the condition documented on a suitable form signed by the HSSO.

The inspection procedure for each type of equipment will follow the manufacturer's recommended procedure (HALLIBURTON NUS SOP No. HS2.05 and HS2.08 contain information for MSA equipment). The specific procedures to be used are available on-site and can be reviewed by contacting _____.

The following schedule will be followed by the HSSO in implementing the inspection requirements:

Equipment	Inspection Date	Person Responsible

4.0 RESPIRATOR STORAGE

All respiratory protection utilized by HALLIBURTON NUS employees must be stored in a convenient, clean, and sanitary location and according to specific manufacturer recommendations. Special attention must be paid to protecting respiratory protection from dusty conditions, temperature extremes, and potential contamination during storage.

The following storage procedures will be utilized for equipment used on a routine basis (i.e., storage during non-use periods of a workshift or storage between workshifts): _____

All equipment not routinely used will be stored according to the procedures outlined below:

Any equipment not assigned to specific site personnel will be stored under the supervision of _____. This equipment will be stored at _____ following the procedures outlined below:

5.0 SURVEILLANCE OF WORK AREA

- Appropriate monitoring of the work area conditions shall be performed frequently to establish the degree of employee exposure or stress. In order to simplify this surveillance, the following procedures have been determined for this project:

Monitoring Equipment Used	Frequency of Surveillance	Personnel/Area Being Monitored

Records of the above surveillance will be recorded on the following forms: (Attach blank field documentation format to be used). Completed forms will be maintained by _____ and can be reviewed at _____.

6.0 QUALITY ASSURANCE OF BREATHING AIR

Compressed air utilized for respiratory protection shall be of high purity. Breathing air shall meet at least the requirements of the specification for Grade D breathing air as established by the Compressed Gas Association. The following specifications must be certified by the vendor/supplier:

Oxygen Content - 19.5 percent to 23.5 percent

Contaminant	Maximum Allowed
Carbon Monoxide (CO)	20 ppm
Carbon Dioxide (CO ₂)	1000 ppm
Condensed Hydrocarbons	5 mg/m ³
Objectional odors	None

Documentation assuring that breathing air meets the above specifications will be obtained by _____ by requesting such documentation from the vendor or supplier.

Site personnel can review this documentation in the _____.

7.0 PROGRAM EVALUATION

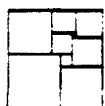
- There will be regular inspections and evaluations to determine the continued effectiveness of this program. Documentation will be maintained by _____, and can be reviewed in the _____.

The program will be evaluated in the following manner:

APPENDIX D

HAZARD COMMUNICATION PROGRAM

ATTACHMENT D-I
HEAT/COLD STRESS



NUS
CORPORATION

**ENVIRONMENTAL
MANAGEMENT GROUP**

STANDARD OPERATING PROCEDURES

Number
HS-09

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Effective Date
05/04/90

Revision
2

Applicability
EMG

Prepared
Health and Safety

Approved
D. Senovich
D. Senovich

Subject

HEAT STRESS CONTROL

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1.0 PURPOSE

To establish procedures for the implementation, operations, and monitoring of a heat stress prevention, evaluation, and response program.

To describe signs and symptoms which characterize excessive exposure of field personnel to heat. Recognition of these signs and symptoms necessitates prompt corrective action to prevent injury or death.

2.0 SCOPE

Applies to all NUS/EMG activities where personnel may be exposed to environments exceeding 70°F.

3.0 GLOSSARY

Wet-Bulb Globe Temperature (WBGT) - This is the simplest and most suitable technique to measure the environmental factors associated with heat stress. The value is calculated by using equations shown in Section 5.2.2 of this procedure.

Work-Rest Regimen - This is a ratio of time spent working versus time spent resting. The ratio applies to 1 hour periods. For example, a work-rest regimen of 75 percent work, 25 percent rest corresponds to 45 minutes work, 15 minutes rest each hour.

4.0 RESPONSIBILITIES

All Site Personnel - All site personnel must be alert to signs and symptoms of heat strain in themselves or in those working with them. Personnel must also be aware of emergency corrective action described in first-aid tests.

Health and Safety Officer (HSO) - The HSO is responsible for implementing heat stress monitoring according to this guideline. He/she also is charged with enforcing the work/rest regime to control heat stress.

5.0 PROCEDURES

5.1 EFFECTS OF HEAT STRESS

Adverse weather conditions are important considerations in planning and conducting site operations. Hot weather can cause physical discomfort, loss of efficiency, and personal injury. Of particular importance is heat stress, resulting when protective clothing decreases natural body ventilation. Because of these factors, a heat stress evaluation procedure is essential to the health and safety of personnel conducting field work.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur ranging from mild (such as fatigue; irritability; anxiety; and decreased concentration, dexterity, or movement) to fatal. Standard reference books shall be consulted for specific first-aid treatment.

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Heat-related problems include:

1. Heat Rash caused by continuous exposure to heat and humid air and aggravated by chafing clothes. Decreases ability to tolerate heat as well as being a nuisance.
2. Heat Cramps caused by profuse perspiration with inadequate fluid intake and chemical replacement (especially salts). Signs: muscle spasms and pain in the extremities and abdomen.
3. Heat Exhaustion caused by increased stress on various organs to meet increased demands to cool the body. Signs: shallow breathing; pale, cool, moist skin; profuse sweating; dizziness; or lassitude.
4. Heat Stroke, the most severe form of heat stress. Body must be cooled immediately to prevent severe injury and/or death. Signs and symptoms are: red, hot, dry skin; no perspiration; nausea, dizziness and confusion; strong, rapid pulse; or coma.

5.2 HEAT STRESS MONITORING

5.2.1 Work-Rest Regimen

In order to establish a proper work-rest regimen, the WBGT may be used in conjunction with the work load required to perform each task. Light work examples include sitting or standing to control machines or performing light hand or arm work. Moderate work includes walking about with moderate lifting and pushing or use of coated coveralls and respirators. Heavy work corresponds to pick and shovel-type work or the use of full body protective clothing. It must be assumed that any activity involving this type of clothing will be considered heavy work.

The work-rest regimen selected, using the WBGT procedure, will be utilized as a baseline. The actual or adjusted period of work will be determined based on the biological monitoring outlined in Section 5.2.3 of this procedure.

5.2.2 WBGT Determination

In order to determine the WBGT the following equations will be used:

- Outdoors with solar load:

$$WBGT = 0.7 NWB + 0.2 GT + 0.1 DB$$
- Indoors or outdoors with no solar load:

$$WBGT = 0.7 NWB + 0.3 GT$$

Where:

WBGT = Wet-Bulb Globe Temperature Index
NWB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

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The factors involved in the equations on page 4 can be measured in the following manner:

- Through the use of a direct-reading heat stress monitor, capable of measuring all of the individual factors associated with the WBGT equation. For example, the Reuter-Strokes Wibget No. RSS-214 heat stress monitor.
- By measuring the individual factors manually, using the following type of equipment:
 - Dry-bulb thermometer
 - Natural wet-bulb thermometer
 - Globe thermometer
 - Stand

The measurement of the individual factors shall be performed as follows:

The range of the dry and the natural wet-bulb thermometers shall be -5°C to 50°C with an accuracy of 0.5°C. The dry-bulb thermometer must be shielded from the sun and the other radiant surfaces of the environment without restricting the airflow around the bulb. The wick of the natural wet-bulb thermometer shall be kept wet with distilled water for at least 1/2 hour before the temperature reading is made. It is an inadequate procedure to immerse the other end of the wick into a reservoir of distilled water and wait until the whole wick becomes wet by capillary. The wick shall be wetted by direct application of water, 1/2 hour before each reading. It shall extend over the bulb of the thermometer, covering the stem about one additional bulb length. The wick should always be clean and a new one shall be washed before using.

A globe thermometer, consisting of a 15cm (6 inch)-diameter hollow copper sphere painted on the outside with a matte black finish or equivalent, shall be used. The bulb or sensor of a thermometer (range -5°C to 100°C with an accuracy of $\pm 0.5^\circ\text{C}$) must be fixed in the center of the sphere. The globe thermometer shall be exposed at least 25 minutes before it is read.

A stand shall be used to suspend the three thermometers so that they do not restrict free air flow around the bulbs; and the dry-bulb, wet-bulb, and globe thermometers are not shaded.

It is permissible to use any other type of temperature sensor that gives identical readings to that of a mercury thermometer under the same conditions.

The thermometers must be so placed that the readings are representative of the conditions where the men work or rest, respectively. All readings shall be recorded on the site log.

5.2.3 Biological Monitoring

One of the following procedures shall be followed when the work-place temperature is 70°F or above, and/or upon this site HSO's discretion, in order to make sure the work/rest regime is providing proper personal protection and to document exposure.

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- Heart rate (HR) shall be measured by the pulse for 30 seconds as early as possible in the resting period. The HR, at the beginning of the rest period, should not exceed 110 beats/min. If the HR is higher, the next work period should be shortened by 10 minutes (or 33 percent), while the length of rest period stays the same. If the pulse rate is 100 beats/min at the beginning of the next rest period, the following work cycle should be shortened by 33 percent. The length of the initial work period will be determined by using the table below.

PERMISSIBLE EXPOSURE THRESHOLD LIMIT VALUES
(Values Are Given in °F WBGT)

Work-Rest Regimen	Work Load		
	Light	Moderate	Heavy
Continuous Work	80.0	80.0	77.0
75% Work - 25% Rest, Each Hour	87.0	82.4	78.6
50% Work - 50% Rest, Each Hour	88.5	85.0	82.2
25% Work - 75% Rest, Each Hour	90.0	88.0	86.0

- Body temperature shall be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature (OT) at the beginning of the rest period should not exceed 99°F. If it does, the next work period should be shortened by 10 minutes (or 33 percent), while the length of the rest period stays the same. However, if the OT exceeds 99.7°F at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent. The worker's OT should be measured at the end of the rest period to make sure that it has dropped below 99°F. At no time shall work begin with an OT above 99°F.

5.3 HEAT STRESS CONTROL

Of particular importance is heat stress, resulting when protective clothing decreases natural body ventilation. One or more of the following will help reduce heat stress:

- Drinking water shall be made available to the workers in such a way that they are stimulated to frequently drink small amounts, i.e., one cup every 15-20 minutes (about 150 ml or 1/4 pint).

The water shall be kept reasonably cool (55-60°F) and shall be placed close to the workplace so that the worker can reach it without abandoning the work area. However, where contaminants are known/suspected to exist that pose an ingestion toxicity hazard potential, workers shall not be permitted to consume any fluids without first being decontaminated and going to a noncontaminated area.

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2. Long cotton underwear acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing. It should be the minimum undergarment worn.
3. When necessary/applicable, install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.
4. In the extremely hot weather, conduct non-emergency response operations in the early morning or evening.
5. In hot weather, rotate shifts of workers wearing impervious clothing.
6. Good hygienic standards must be maintained by frequent changes of clothing and daily showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.
7. Acclimatization to heat involves a series of physiological and psychological adjustments that occur in an individual during his first week of exposure to hot environmental conditions. The work-rest regimen in this procedure is valid for acclimated workers who are physically fit. Extra caution must be employed when unacclimated or physically unfit workers must be exposed to heat stress conditions.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.



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MANAGEMENT GROUP**

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Prepared
Health and Safety

Approved
D. Senovich
D. Senovich

Subject

COLD STRESS CONTROL

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1.0 PURPOSE

To establish procedures for the implementation, operation, and monitoring of a cold stress prevention, evaluation, and response program.

To describe signs and symptoms which characterize excessive exposure of field personnel to cold environments. Recognition of these signs and symptoms necessitates prompt corrective action to prevent injury or death.

2.0 SCOPE

Applies to all NUS/EMG activities, where personnel may be exposed to environments with an ambient temperature of 30°F or less.

3.0 GLOSSARY

Frostbite - Local tissue damage caused by exposure to low temperature environmental conditions. Severe occurrence may lead to deep tissue damage, gangrene, and loss of the affected parts.

Hypothermia - Lowering of the body core temperature due to exposure to cold. Severe hypothermia may result in the death of the victim.

Equivalent Chill Temperature (ECT) - An index describing the effect of the cooling power of moving air on exposed flesh. The effect of wind velocity at a certain temperature is expressed as the equivalent cooling effect of a lower temperature with still air.

ACGIH TLV 1985/6 - Cold Stress Threshold Limit Values (TLVs) are intended to protect workers from the severest effects of cold stress (hypothermia) and cold injury as well as to describe exposures to cold working conditions, under which it is believed that nearly all workers can be repeatedly exposed without adverse health effects. The TLV objective is to prevent the deep body core temperature from falling below 36°C (96.8°F) and to prevent cold injury to body extremities. Deep body temperature is the core temperature of the body as determined by rectal temperature measurements. For a single, occasional exposure to a cold environment, a drop in core temperature of no lower than 35°C (95°) should be permitted. In addition to provisions for total body protection, the TLV objective is to protect all parts of the body (with an emphasis on hands, feet, and head) from cold injury. Cold stress TLVs are currently tentative and portions are quoted with permission of the ACGIH.

4.0 RESPONSIBILITIES

All Site Personnel - All site personnel must be alert to signs of development of excessive cold stress in those working with them and shall be aware of emergency action described in first-aid texts.

Health and Safety Officer (HSO) - The HSO is responsible for implementing a cold stress monitoring according to this guideline. He/she is charged with enforcing the work/warm up regimen to control cold stress.

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5.0 PROCEDURES

5.1 EFFECTS OF COLD STRESS

Persons working outdoors in temperatures at or below freezing may experience frostbite. Extreme cold for a short time may cause severe injury to the surface of the body. Areas of the body that have a high surface area to volume ratio, such as fingers, toes, and ears, are the most susceptible.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill (Table 1, Attachment A) is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 mph is equivalent in chilling effect to still air at -18°F.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed, if the clothing underneath is soaked with perspiration.

5.2 FROSTBITE

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

1. Frost nip or incident frostbite - the conditions are characterized by sudden blanching or whitening of skin.
2. Superficial frostbite - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
3. Deep frostbite - tissues are cold, pale, and solid; extremely serious injury.

5.3 HYPOTHERMIA

Authorities agree that there are degrees of hypothermia which are characterized as "moderate" and "severe". A victim of moderate hypothermia, who may exhibit the first seven signs listed in 5.3.1, is still conscious but often confused. Severe hypothermia is determined by extreme skin coldness; loss of consciousness; faint pulse; and shallow, infrequent, or apparently absent respiration. Death is the ultimate result. (See Attachment B.)

Practically, the onset of severe shivering signals danger to personnel. Exposure to cold shall be immediately terminated for any severely shivering worker.

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5.3.1 Signs of Hypothermia

1. Severe shivering
2. Abnormal behavior
3. Slowing
4. Stumbling
5. Weakness
6. Repeated falling
7. Inability to walk
8. Collapse
9. Stupor
10. Unconsciousness

5.4 EMERGENCY ACTION

1. Remove the victim from the hypothermia-/frostbite-producing environment.
2. Seek expert medical help immediately.
3. Reduce handling to a minimum. Do not rub or massage the victim.
4. Prevent further body heat loss by covering the victim lightly with blankets. Plastic may be used for further insulation. Do not cover the victim's face.
5. If the victim is still conscious, administer hot drinks. Encourage activity, such as walking while wrapped in a blanket. Do not administer any form of sedative, tranquilizer, or analgesic (pain reliever), because these may facilitate further heat loss and convert moderate hypothermia into a severe case.

5.5 WORK-PLACE MONITORING

Work-place monitoring is required as follows:

1. A thermometer accurate to 1°F shall be assigned at any workplace where the environmental temperature is known or expected to be below 60°F, to enable overall compliance with the requirements of this procedure.
2. Whenever the air temperature at a work place falls to 30°F or below, the dry-bulb temperature and wind speed shall be measured and recorded at least every 4 work-hours.
3. The equivalent chill temperature shall be obtained from Table 1 (in all cases where air movement measurements are required) and shall be recorded with the other data in the site log, together with a record of the length of time spent working and resting.

5.6 WORK-WARMING REGIMEN

If work is performed continuously in the cold at an ECT of 20°F or below, heated warming shelters shall be made available for use by employees during warmup breaks. A work-warming regimen will be established using Table 2 (Attachment C). This table assumes that all workers are properly clothed for periods of work temperatures below freezing.

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When entering the heated shelter, the outer layer of clothing shall be removed and the remainder of the clothing loosened to permit sweat evaporation or a change of dry work clothing provided. A change of dry work clothing shall be provided, as necessary, to prevent workers from returning to their work with wet clothing. Dehydration, or the loss of body fluids, occurs insidiously in the cold environment and may increase the susceptibility of the worker to cold injury due to a significant change in blood flow to the extremities. Warm sweet drinks and soups should be provided at the work site to provide caloric intake and fluid volume. The intake of coffee shall not be permitted because of a diuretic and circulatory effect.

For work practices at or below 10°F ECT the following shall apply:

1. The worker shall be under constant protective observation (buddy system or other direct supervision).
2. The work rate should not be high enough to cause sweating that results in wet clothing. If heavy work must be done, all rest periods must be taken in heated shelters and the opportunity for changing into dry clothing shall be provided.
3. Provision shall be made to make sure employees shall become accustomed to the working conditions and required protective clothing.
4. The weight and bulkiness of clothing as well as the required work performance and weights to be lifted by the worker shall be included in estimating.
5. The work shall be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats shall not be used. The worker should be protected from drafts to the greatest extent possible.
6. The workers shall be instructed in cold weather procedures. The training program shall include, as a minimum, instruction in:
 - a. Proper rewarming procedures and appropriate first-aid treatment.
 - b. Proper clothing practices.
 - c. Proper eating and drinking habits.
 - d. Recognition of impending frostbite.
 - e. Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body, even when shivering does not occur.
 - f. Safe work practices.

5.7 SPECIAL MEDICAL CONSIDERATIONS

Employees shall be excluded from work in the cold at 30°F or below if they are suffering from diseases or taking medication, which interferes with normal body temperature regulation or reduces tolerance to work in cold environments. The HSO shall document this situation for each worker during site training. Workers who are routinely exposed to temperatures below -10°F (with wind speeds less than 5 miles per hour) or air temperature below 0°F (with wind speeds less than 5 miles per hour) should be medically-certified as suitable for such exposures.

Trauma sustained in freezing or subzero conditions requires special attention, because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues, in addition to providing for first-aid treatment.

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For exposed skin, continuous exposure will not be permitted when an ECT of -25°F is anticipated.

At air temperatures of 36°F or less, any worker who becomes immersed in water or whose clothing becomes wet will be immediately be provided with a change of clothing and be treated for hypothermia.

5.8 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

Since prolonged exposure to cold air or to immersion in cold water (at temperatures well above freezing) can lead to dangerous hypothermia, whole body protection must be provided as follows:

- Adequate insulating clothing, to maintain core temperatures above 97°F, must be provided to workers if work is performed in air temperatures below 40°F. Wind chill or the cooling power of the air is a critical factor. As wind speed increases and work area temperature decreases, the insulation values of the workers' protective clothing must increase. An equivalent chill temperature chart, relating the actual dry bulb air temperature and the wind velocity, is presented in Attachment A. The equivalent chill temperature must be used when estimating the combined cooling effects of wind and low air temperatures on exposed skin or when determining clothing insulation requirements to maintain the deep body core temperature.
- Older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions which shall be considered. The precautionary actions to be taken will depend upon the physical condition of the work and shall be determined with the advice of a physician who knows cold stress factors and the medical condition of the worker.
- Special protection of the hands is required to maintain manual dexterity as follows:
 - If fine work is to be performed with bare hands for more than 10-20 minutes in an environment below 60°F, special provisions shall be established for keeping the worker's hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars shall be covered by thermal insulating material at temperatures below 30°F.
 - If the air temperature falls below 60°F for sedentary, 40°F for light, or 20°F for moderate work (and fine manual dexterity is not required), then gloves shall be used by the workers.
- To prevent contact frostbite, the workers must wear anticontact gloves and follow the provisions shown below:
 - When cold surfaces below 20°F are within reach, a warning should be given to each worker by his supervisor to prevent inadvertent contact by bare skin.
 - If the air temperature is 0°F or less, the hands should be protected by mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

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- Provisions for additional total body protection is required if work is performed in an environment at or below 40°F. The workers shall wear cold protective clothing that is appropriate for the level of cold and physical activity:
 - If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind shall be reduced by shielding the work area or by wearing an easily removable outer windbreak garment.
 - If only light work is involved and if the clothing on the worker may become wet on the job site, the outer layer of the clothing in use shall be impermeable to water. The outer garments must include provisions for easy ventilation in order to prevent wetting of inner layers by sweat. If work is done at normal temperatures or in a hot environment before entering the cold area, the employee shall make sure that his/her clothing is not wet from sweating. If his/her clothing is wet, the employee shall change into dry clothes before entering the cold area. The workers shall change socks and any removable felt insoles at regular daily intervals or use vapor barrier boots. The optimal frequency of change shall be determined empirically and will vary individually, depending on the type of shoe worn and how much the individual's feet sweat.
 - If workers' extremities, ears, toes, and noses, cannot be protected sufficiently by handwear, footwear, and face masks to prevent sensation of excessive cold or frostbite, the protective items shall be supplied in auxiliary heated versions.
 - If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work shall be modified or suspended until adequate clothing is made available or until weather conditions improve.
 - Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F shall take special precautions to avoid soaking of clothing or gloves with the liquids. This is because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of "cryogenic fluids" or those liquids with a boiling point just above ambient temperatures.

6.0 REFERENCES

ACGIH TLV Booklet, 1985-1986.

7.0 ATTACHMENTS

Attachment A - Cooling Power of Wind on Exposed Flesh Expressed as an Equivalent Temperature
 Attachment B - Signs of Hypothermia
 Attachment C - Work/Warm-up Schedule for 4-Hour Shift

**ATTACHMENT A
TABLE 1**

COOLING POWER OF WIND ON EXPOSED FLESH EXPRESSED AS AN EQUIVALENT TEMPERATURE (UNDER CALM CONDITIONS)*

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
Equivalent Chill Temperature (°F)												
calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER				INCREASING DANGER				GREAT DANGER			
	In < hr with dry skin. Maximum danger of false sense of security.				Danger from freezing of exposed flesh within one minute.				Flesh may freeze within 30 seconds.			
Trenchfoot and immersion foot may occur at any point on this chart.												

*Developed by U. S. Army Research Institute of Environmental Medicine, Natick, MA.

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**ATTACHMENT B
SIGNS OF HYPOTHERMIA**

Core Temperature		Clinical Signs
°C	°F	
37.6	99.6	"Normal" rectal temperature.
37	98.6	"Normal" oral temperature.
36	96.8	Metabolic rate increases in an attempt to compensate for heat loss.
35	95.0	Maximum shivering.
34	93.2	Victim conscious and responsive, with normal blood pressure.
33	91.4	Severe hypothermia below this temperature.
32 31	89.4 87.8	Consciousness clouded, blood pressure becomes difficult to obtain but reacts to light; shivering ceases.
30 29	86.0 84.2	Progressive loss of consciousness; muscular rigidity increases; pulse and blood pressure difficult to obtain; respiratory rate decreases.
28	82.4	Ventricular fibrillation possible with myocardial irritability.
27	80.6	Voluntary motion ceases; pupils nonreactive to light; deep tendon and superficial reflexes absent.
26	78.8	Victim seldom conscious.
25	77.0	Ventricular fibrillation may occur spontaneously.
24	75.2	Pulmonary edema.
22 21	71.6 69.8	Maximum risk of ventricular fibrillation.
20	68.0	Cardiac standstill.
18	64.4	Lowest accidental hypothermia victim to recover.
17	62.6	Isoelectric electroencephalogram.
9	48.2	Lowest artificially cooled hypothermia patient to recover.

ATTACHMENT C
TABLE 2
WORK/WARM-UP SCHEDULE FOR 4-HOUR SHIFT*

Air Temp <u>Sunny Sky</u> °F	No Noticeable Wind		5 mph Wind		10 mph Wind		15 mph Wind		20 mph Wind	
	Max No of Period	Work Breaks	Max. No of Period	Work Breaks	Max No of Period	Work Breaks	Max. No. of Period	Work Breaks	Max No of Period	Work Breaks
1. -15° to -19°	(Norm Breaks)	1	(Norm. Bre		min	2	55 min	3	40 min	4
2. -20° to -24°	(Norm Breaks)	1	75 min.	2	55 min	3	40 min	4	30 min	5
3. -25° to -29°	75 min.	2	55 min	3	40 min	4	30 min.	5	Nonemergency work should cease.	
4. -30° to -34°	55 min.	3	40 min	4	30 min	5	Nonemergency work should cease			
5. -35° to -39°	40 min.	4	30 min.	5	Nonemergency work should cease					
6. -40° to -44°	30 min.	5	Nonemergency work should cease							
7. -45° & below	Nonemergency work should cease.									

Notes:

- Schedule applies to moderate to heavy work activity with warm up breaks of 10 minutes in a warm location. For light to moderate work (limited physical movement): apply the schedule one step lower. For example, at -30°F with no noticeable wind (Step 4), a worker at a job with little physical movement should have a maximum work period of 40 minutes with four breaks in a 4 hour period (Step 5)
- The following is suggested as a guide for estimating wind velocity. If accurate information is not available -- 5 mph: light flag moves; 10 mph: light flag fully extended; 15 mph: raises newspaper sheet; 20 mph: blowing and drifting snow.

*From Occupational Health & Safety Division, Saskatchewan Department of Labor

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ATTACHMENT D-II

**MONITORING INSTRUMENTATION
STANDARD OPERATING PROCEDURES
HNu PI-101; OVA MODEL 128; LEL/O2**

Subject HNU PI-101 ORGANIC VAPOR METER	Number ME-01	Page 2 of 12
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1.0 PURPOSE

To establish procedures for the use, maintenance, and calibration of the HNU PI-101 Organic Vapor Meter.

2.0 SCOPE

Applies to each usage of the HNU PI-101 photoionization detector by NUS/EMG personnel.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Office Health and Safety Supervisor (OHSS) - The OHSS shall insure that the user has been appropriately trained and certified in the usage of the HNU instrument. He/she shall also insure that the instrument is properly maintained and calibrated prior to its release for field service.

Instrument User - The user should be personally secure that he/she has been adequately trained and understands the operation and limitations of the instrument. He/she is further responsible to insure that the appropriate probe(s) have been selected for compounds to be found on site and that the instrument has been calibrated and is working properly.

5.0 PROCEDURES

5.1 PRINCIPLE OF OPERATION

The HNU System portable photoionizer detects the concentration of many organic gases as well as a few inorganic gases. The basis for detection is the ionization of gaseous species. The incoming gas molecules are subjected to ultraviolet (UV) radiation, which is energetic enough to ionize many gaseous compounds. The molecule is transformed into charged-ion pairs, creating a current between two electrodes. Each molecule has a characteristic ionization potential, which is the energy required to remove an electron from the molecule, yielding a positively-charged ion and the free electron. The instrument measures this energy level.

5.2 INSTRUMENT CONFIGURATION

Three probes, each containing a different UV light source, are available for use with the HNU. Probe energies are 9.5, 10.2, and 11.7eV. All three detect many aromatic and large-molecule hydrocarbons. The 10.2 and 11.7eV probes, in addition, detect some smaller organic molecules and some halogenated hydrocarbons. The 10.2eV probe is the most useful for environmental response work, since it is more durable than the 11.7eV probe and detects more compounds than the 9.5eV probe.

5.3 CALIBRATION

The primary HNU calibration gas is benzene (or isobutylene, a benzene equivalent). The span potentiometer knob is adjusted for benzene calibration. A knob setting of zero increases the sensitivity to benzene approximately ten-fold. The instrument's response can be adjusted to give more accurate readings for specific gases and eliminate the necessity for calibration charts. Daily calibration is to be performed in accordance with Attachment G.

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5.4 SPECIALIZED USES

While the HNU is used primarily as a qualitative instrument, it can also be used to detect certain contaminants or at least to narrow the range of possibilities. Noting instrument response to a contaminant source with different probes can eliminate some contaminants from consideration. For instance, a compound's ionizing potential may be such that the 9.5eV probe produces no response, but the 10.2 and 11.7eV probes do elicit a response. Also, HNU does not detect methane or hydrogen cyanide.

5.5 INSTRUMENT ADVANTAGES

The HNU is easy to use in comparison to many other types of monitoring instrumentation. Its range detection limit is also in the low parts per million range. Response time is rapid; the meter needle reaches 90 percent of the indicated concentration in 3 seconds for benzene. HNU can be zeroed in a contaminated atmosphere.

5.6 CAUTIONS

The instrument can monitor only certain vapors and gases in air. Nonvolatile liquids, toxic solids, particulates, and many other toxic gases and vapors cannot be detected. Because the types of compounds that the HNU can detect is only a fraction of the chemicals possibly present at a field site, a zero reading does not necessarily signify the absence of air contaminants.

The instrument is nonspecific, and its response to different compounds is relative to the calibration setting. Instrument readings may be higher or lower than the true concentration. These discrepancies can be especially serious problems when monitoring for total contaminant concentrations, if several different compounds are being detected at once. In addition, the response of this instrument is not linear over the entire detection range. Care must, therefore, be taken when interpreting the data. All identifications should be reported as tentative until they can be confirmed by more precise analysis. Concentrations should be reported in terms of the calibration gas and span potentiometer of the gas-select-knob setting.

The instrument cannot be used as an indicator for combustible gases or oxygen deficiency.

6.0 REFERENCES

HNU Systems, Inc. Instruction Manual for Model PI 101 Photoionization Analyzer, 1975.

E. & E. FIT Operation and Field Manual: HNU Systems PI 101 Photoionization Detector and Century Systems (Foxboro) Model OVA-128 Organic Vapor Analyzer.

Personal Communication with Fran Connel, HNU Systems, Inc., January 4, 1984.

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7.0 ATTACHMENTS

Attachment A - Start-up and Shutdown Procedures
 Attachment B - Maintenance and Calibration Schedule
 Attachment C - Calibration Procedure
 Attachment D - Cleaning the UV Light Source Window
 Attachment E - Cleaning the Ionization Chamber
 Attachment F - Troubleshooting
 Attachment G - Daily Calibration

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ATTACHMENT A

START-UP AND SHUTDOWN PROCEDURES

Start-up

1. Attach the probe to the readout unit. Match the alignment key, then twist the connector clockwise until a distinct locking is felt.
2. Turn the FUNCTION switch to the battery check position. Check to ensure that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged prior to using.
3. To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15-20 seconds to ensure that the zero adjustment is stable. If not, then readjust.
4. Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used. Follow procedures in Attachment G in the performance of daily calibrations.
5. Set the FUNCTION switch to the desired ppm range.
6. Listen for the fan operation to verify fan function.
7. Check instrument with an organic point source (such as a magic marker) prior to usage to verify instrument function.

Shut Down

1. Turn FUNCTION switch to OFF.
2. Place the instrument on the charger.

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ATTACHMENT B

MAINTENANCE AND CALIBRATION SCHEDULE

<u>Function</u>	<u>Frequency</u>
● Routine Calibration	Prior to each use*
● Factory Check-out and Calibration	Yearly or when malfunctioning
● Wipe Down Read-Out Unit	After each use
● Clean UV Light Source Window	Every month or as use and site conditions dictate
● Clean the Ionization Chamber	Monthly
● Recharge Battery	After each use

* In accordance with the specifications identified in Attachment G.

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ATTACHMENT C
CALIBRATION PROCEDURE

Calibration Procedure 1

1. Run through start-up procedures as per Attachment 1.
2. Fill a sampling bag with HNU calibration gas of known contents.
3. Allow sample bag contents to be drawn into the probe and check response in ppm.
4. If the reading deviates ± 15 percent from the concentration of the calibration gas, the instrument requires maintenance.
5. Each office must develop a mechanism for the documentation of calibration results. This documentation includes:
 - a. date inspected
 - b. person who calibrated the instrument
 - c. the instrument number (Serial number or Other ID number)
 - d. the result of the calibration (ppm, probe ev, span pot setting)
 - e. identification of the calibration gas (source, type, concentration)

Calibration Procedure 2 (for HNU Calibration Canisters Equipped with a Regulator)

1. Run through start up procedures as per Attachment 1.
2. Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNU.
3. Crack the regulator valve.
4. Take reading after 5-10 seconds.
5. If the reading deviates ± 15 percent from the concentration of the calibration gas, the instrument requires maintenance.
6. Calibration documentation should be as in No. 5 above.

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ATTACHMENT D

CLEANING THE UV LIGHT SOURCE WINDOW

1. Turn the FUNCTION switch to the OFF position and disconnect the sensor/probe from the Read Out/Control unit.
2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.
3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp housing, taking care that the lamp does not fall out of this housing.
4. Tilt the lamp housing with one hand over the opening, so that the lamp slides out of the housing into your hand.
5. The lamp window may now be cleaned with any of the following compounds using lens paper:
 - a. HNU Cleaning Compound-All lamps except the 11.7 eV
 - b. Carbon tetrachloride-All lamps except the 11.7 eV
 - c. Methanol-All lamps
6. Following cleaning, reassemble by first sliding the lamp back into the lamp housing. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.
7. Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.
8. Line up the pins on the base of the lamp housing with pins inside the probe shell and slide the housing assembly into the shell. It will only fit one way.

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ATTACHMENT E

CLEANING THE IONIZATION CHAMBER

1. Turn the FUNCTION switch to the OFF position and disconnect the sensor/probe from the Read Out/Control unit.
2. Remove the exhaust screw located near the base of the probe. Grasp the end cap in one hand and the probe shell in the other. Separate the end cap and lamp housing from the shell.
3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp housing, taking care that the lamp does not fall out of this housing.
4. The ion chamber may now be cleaned according to the following sequence:
 - a. acetone rinse with agitation (10 min.), then dry (preferably with oven at 100°C).
 - b. methanol rinse with agitation (10 min.), then dry (preferably with oven at 100°C).
5. Place the ion chamber on top of the housing, making sure the contacts are properly aligned.
7. Place the end cap on top of the ion chamber and replace the two screws. Tighten the screws only enough to seal the O-ring. Do Not Overtighten.
8. Line up the pins on the base of the lamp housing with pins inside the probe shell and slide the housing assembly into the shell. It will only fit one way.

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ATTACHMENT F

TROUBLESHOOTING

To be performed by qualified technician only.

1. No meter response in any switch position (including BATT CHK).
 - A. Broken meter movement.
 - (1) Tip instrument rapidly from side to side. Meter needle should move freely and return to zero.
 - B. Electrical connection to meter is broken.
 - (1) Check all wires leading to meter and clean the contacts of quick-disconnects.
 - C. Battery is completely dead.
 - (1) Disconnect battery and check voltage with a volt-ohm meter.
 - D. If none of the above solves the problem, consult the factory.
2. Meter responds in BATT CHK position, but reads zero or near zero for all others.
 - A. Power supply defective.
 - (1) Check power supply voltages per Figure 11 of the HNU owner's manual. If any voltage is out of specification, consult the factory.
 - B. Input transistor or amplifier has failed.
 - (1) Rotate zero control; meter should deflect up/down, as control is turned.
 - (2) Open probe. Both transistors should be fully seated in sockets.
 - C. Input signal connection broken in probe or readout.
 - (1) Check input connector on printed circuit board. The input connector should be firmly pressed down.
 - (2) Check components on back side of printed circuit board. All connections should be solid and no wires should touch any other object.
 - (3) Check all wires in readout for solid connections.

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ATTACHMENT G

DAILY CALIBRATION OF HNU PI-101

HNU PI-101 organic vapor meters are to be field calibrated at the beginning of each work day, prior to actual on site usage.

In order to accomplish this, HNUs assigned to jobs shall be accompanied with a calibration gas cylinder, an appropriate fitting, and a flexible connecting hose. The procedure for performing field calibration is as follows:

1. Connect the probe to the instrument and turn it on.
2. Attach the eight-inch extension to the probe.
3. Set the Span Potentiometer to the setting specified on the calibration cylinder.
4. Connect the cylinder fitting to the cylinder.
5. Connect the cylinder and the instrument together with the flexible tubing.
6. Open the cylinder valve and wait 15 seconds.
7. Instrument reading should coincide with the designed reading stated on the calibration cylinder label.
8. If item number 7 does not coincide, adjust the Span Potentiometer until the desired reading is achieved. Any such adjustments must be within the following limits:

Probe	Initial Span Pot. Setting	Maximum Acceptable Span Pot. Adjustment
9.5 eV	5.0	1.0
10.2 eV	9.8	8.5
11.7 eV	5.0	2.0

If these limits are exceeded, the sensitivity and accuracy of the instrument is hindered. At these points, the instruments are to be returned to the NUS Equipment Manager for inspection, necessary cleaning and maintenance, and recalibration.

The manufacturer also recommends that the lamp inside of the probe be checked twice per week (16 hours of use) and cleaned at least weekly. This involves removing any noticeable obstructions or contamination from the lamp by wiping it off with a clean, soft cloth being careful not to scratch the circular window.

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**ATTACHMENT G
DAILY CALIBRATION OF HNU PI-101
PAGE TWO**

In using this instrument to protect NUS employees and subcontractors, it is imperative that it is accurately responding to airborne substances present at the work site. By implementing these procedures, this end will be better achieved.

Additionally, all calibration activities must be documented in field log books, instrument calibration log sheets, or equivalent. This information must include the date inspected, the person calibrating the instrument, the instrument serial or identification number, the probe lamp eV (9.5, 10.2, or 11.7), identification of calibration gas (gas source stated on the cylinder label), the initial and final Span Potentiometer settings, and the instrument resultant reading. This information must be submitted to the Site Safety officer at the completion of the job.



NUS
CORPORATION

**ENVIRONMENTAL
MANAGEMENT GROUP**

STANDARD OPERATING PROCEDURES

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Applicability
EMG

Prepared
Health and Safety

Approved
D. Senovich
D. Senovich

Subject

OVA 128 ORGANIC VAPOR ANALYZER

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1.0 OBJECTIVE

To establish procedures for the use, maintenance, and calibration of the OVA 128 Vapor Analyzer.

2.0 SCOPE

Applies to each usage of the OVA instrument in implementation of the NUS/EMG Program.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Office Health and Safety Supervisor (OHSS) - The OHSS shall insure that the user has been appropriately trained and certified in the usage of the OVA. He shall also insure that the instrument is properly maintained and calibrated prior to its release for field service.

Instrument User - The user should be personally secure that he or she has been adequately trained, understands the operation of the OVA, and limitations of the instrument. He or she should also be sure that the instrument has been calibrated and is working properly.

5.0 PROCEDURES

5.1 PRINCIPLE OF OPERATION

The OVA operates in two different modes. In the survey mode, it can determine the approximate concentration of all detectable species in air. With the gas chromatograph option, individual components can be detected and measured independently, with some detection limits as low as a few parts per billion.

5.2 GAS CHROMATOGRAPH FUNCTION

In the Gas Chromatograph (GC) mode, a small sample of ambient air is injected into a chromatographic column and carried through the column by a stream of hydrogen gas. Contaminants with different chemical structures are retained on the column for different lengths of time (known as retention times) and, hence, are detected separately by the flame ionization detector. A strip chart recorder can be used to record the retention times, which are then compared to the retention times of a standard with known chemical constituents. The sample can be injected into the column either from the air-sampling hose or directly from a gas-tight syringe.

5.3 CALIBRATION

The OVA is internally calibrated to methane by the manufacturer. When measuring methane, it indicates the true concentration. In response to all other detectable compounds, however, the instrument reading may be higher or lower than the true concentration. Relative response ratios for substances other than methane are available. To interpret the readout correctly, it is necessary either to make calibration charts relating the instrument readings to the true concentrations or to adjust the instrument, so that it reads correctly. This second procedure is done by turning the 10-turn, gas-select knob, which adjusts the response of the instrument. The knob is normally set at 300 when calibrated

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to methane. Secondary calibration to another gas is done by sampling a known concentration of the gas and adjusting the gas-select knob, until the instrument reading equals the true concentration.

5.4 LIMITATIONS

The OVA has an inherent limitation in that it can detect only organic molecules. Also, it should not be used at temperatures lower than about 40°F, because gases condense in the pump and column. It has no temperature control and, since retention times vary with ambient temperatures for a given column, absolute determinations of contaminants are difficult. Despite these limitations, the GC mode can often provide tentative information on the identity of contaminants in air without relying on costly, time-consuming laboratory analysis.

5.5 CAUTIONS

The instrument can monitor only certain vapors and gases in air. Many nonvolatile liquids, toxic solids, particulates, and other toxic gases and vapors cannot be detected. Because the types of compounds that the OVA can potentially detect are only a fraction of the chemicals possibly present at an incident, a zero reading does not necessarily signify the absence of air contaminants.

The instrument is nonspecific, and its response to different compounds is relative to the calibration setting. Instrument readings may be higher or lower than the true concentrations. These discrepancies can be especially serious problems when monitoring for total contaminant concentrations, if several different compounds are being detected at once. In addition, the response of this instrument is not linear over the entire detection range. Care must, therefore, be taken when interpreting the data. All identifications should be reported as tentative until they can be confirmed by more precise analysis. Concentrations should be reported in terms of the calibration gas and span potentiometer or gas-select knob setting.

This instrument cannot be used as an indicator for combustible gases or oxygen deficiency.

6.0 REFERENCES

Century Systems (Foxboro). Service Procedures: Organic Vapor Analyzer; 128GC.

7.0 ATTACHMENTS

- Attachment A - Start-up and Shutdown Procedures (2 Sheets)
- Attachment B - Maintenance and Calibration Schedule
- Attachment C - Calibration Procedure (2 Sheets)
- Attachment D - Pump System Checkout
- Attachment E - Burner Chamber Cleaning
- Attachment F - Quad Ring Service
- Attachment G - Troubleshooting (2 Sheets)
- Attachment H - Shipping
- Attachment I - D.O.T. Exemption Permit (2 Sheets)
- Attachment J - D.O.T. Exemption Permit Extension
- Attachment K - Hydrogen Recharging
- Attachment L - Particle Filter Servicing
- Attachment M - Flow Diagram - Gas Handling System

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ATTACHMENT A

START-UP AND SHUTDOWN PROCEDURES

START-UP

1. Connect the probe/read out connectors to the side-pack assembly.
2. Check battery condition and hydrogen supply.
3. For measurement taken as methane equivalent, check that the GAS SELECT Dial is set at 300.
4. Turn the electronics on by moving the INSR switch to the ON position and allow five (5) minutes for warm-up.
5. Set CALIBRATE switch to X10, use CALIBRATE knob to set indicator at 0.
6. Open the H₂ tank valve and the H₂ supply valve all the way. Check that the hydrogen supply gauge reads between 8.0 and 12.0 psig.
7. Turn the PUMP switch ON and check the flow system, according to the procedures in Attachment D.
8. Check that the BACKFLUSH and INJECT valves are in the UP position.
9. To light the flame, depress the igniter switch until a meter deflection is observed. The igniter switch may be depressed for up to five (5) seconds. Do not depress for longer than five (5) seconds, since it may burn out the igniter coil. If the instrument does not light, allow it to run several minutes and repeat ignition attempt.
10. Confirm OVA operational state by sniffing an organic source, such as a magic marker.
11. Establish a background level in a clean area, by using the charcoal scrubber (depress the sample inject valve) and recording measurements referenced to background.
12. Set the alarm level, if desired.

SHUT DOWN

1. Close H₂ supply valve and H₂ tank valve (Do Not Overtighten Valves).
2. Turn INSTR switch to OFF.
3. Wait until H₂ supply gauge indicates system is purged of H₂, then switch off pump.
4. Put instrument on electrical charger at completion of day's activities.

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ATTACHMENT B

MAINTENANCE AND CALIBRATION SCHEDULE

- Check Particle Filters Weekly or as-needed
 - Check Quad Rings Monthly or as-needed
 - Clean Burner Chamber Monthly or as-needed
 - Secondary Calibration Check Prior to project start-up
 - Primary Calibration Check Monthly or if secondary check is off by more than $\pm 10\%$
 - Check Pumping System Prior to project start-up
 - Replace Charcoal 120 hours of use or when background readings are higher with the inject valve down than with the inject valve up, in a clean environment.
 - Factory Service At least annually
- * Instruments which are not in service for extended periods of time need not meet the above schedule. However, they must be given a complete check-out prior to their first use addressing the above maintenance items.

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ATTACHMENT C
CALIBRATION PROCEDURE

PRIMARY CALIBRATION

1. Remove instrument components from the instrument shell.
2. Turn on Electronics and Zero instrument on X10 scale. Gas select dial to 300.
3. Turn on Pump and Hydrogen. Ignite Flame. Go to Survey Mode.
4. Introduce a Methane Standard near 100 ppm.
5. Adjust R-32 Trimpot on Circuit Board to make meter read to standard.
6. Turn off hydrogen flame and adjust meter needle to read 40 ppm (calibrate @ X10) using the calibration adjust knobs.
7. Switch to X100 Scale. The meter should indicate 0.4 on the 1-10 meter markings (0.4 x 100 = 40 ppm). If the reading is off, adjust with R33 Trimpot.
8. Return to X10 Scale and adjust meter needle to 40 ppm with calibration adjust knob, if necessary.
9. At the X10 Scale, adjust meter to read 0.4 on the 1-10 meter markings using the calibration adjust. Switch to X1 scale. The meter should read 4 ppm. If the reading is off, adjust using the R-31 Trimpot.

SECONDARY CALIBRATION

1. Fill an air sampling bag with 100 ppm (Certified) methane calibration gas.
2. Connect the outlet of the air sampling bag to the air sampling line of the OVA.
3. Record the reading obtained off the meter onto the calibration record.

DOCUMENTATION

Each office shall develop a system, whereby the following calibration information is recorded.

- a. Instrument calibrated (I.D. or Serial No.)
- b. Date of calibration
- c. Method of calibration
- d. Results of the calibration
- e. Identification of person who calibrated the instrument
- f. Identification of the calibration gas (source, type, concentration, Lot No.)

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ATTACHMENT D

PUMP SYSTEM CHECKOUT

1. With pump on hold unit upright and observe flow gauge.
2. Ball level significantly below a reading of 2 is inadequate flow.
3. Check connections at the sample hose.
4. Clean or replace particle filters, if flow is impaired or it is time for scheduled service.
5. Reassemble and retest flow.
6. If flow still inadequate, replace pump diaphragm and valves.
7. If flow normal, plug air intake. Pump should slow and stop.
8. If no noticeable change in pump, tighten fittings and retest.
9. If still no change, replace pump diaphragm and valves.
10. Document this function in the maintenance records.

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ATTACHMENT E
BURNER CHAMBER CLEANING

1. Remove plastic exhaust port cover.
2. Unscrew exhaust port.
3. Use wire brush to clean burner tip and electrode. Use wood stick to clean Teflon.
4. Brush inside of exhaust port.
5. Blow out chamber with a gentle air flow.
6. Reassemble and test unit.
7. Document this function in the maintenance records.

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ATTACHMENT F
QUAD RING SERVICE

1. Remove OVA guts from protective shell.
2. Remove clip ring from bottom of valve.
3. Unscrew nut from top of valve.
4. Gently pull valve shaft upward and free of housing.
5. Observe rings for signs of damage - replace as necessary.
6. Lightly grease rings with silicone grease.
7. Reassemble valve - do not pinch rings during shaft insertion.
8. Document this function in the maintenance records.

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ATTACHMENT G
TROUBLESHOOTING

Indication	Possible Causes
<ul style="list-style-type: none"> High Background Reading (More than 10 ppm) 	<ol style="list-style-type: none"> Contaminated Hydrogen Contaminated Sample Line
<ul style="list-style-type: none"> Continual Flameout 	<ol style="list-style-type: none"> Hydrogen Leak Dirty Burner Chamber Dirty Air Filters
<ul style="list-style-type: none"> Low Air Flow 	<ol style="list-style-type: none"> Dirty Air Filter Pump Malfunction Line Obstruction
<ul style="list-style-type: none"> Flame Will Not Light 	<ol style="list-style-type: none"> Low Battery Ignitor Broken Hydrogen Leak Dirty Burner Chamber Air Flow Restricted
<ul style="list-style-type: none"> No Power to Pump 	<ol style="list-style-type: none"> Low Battery Short Circuit
<ul style="list-style-type: none"> Hydrogen Leak (Instrument Not in Use) 	<ol style="list-style-type: none"> Leak in Regulator Leak in Valves

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**ATTACHMENT G
TROUBLESHOOTING
PAGE TWO**

To be performed by qualified technician only.

1. No meter response in any switch position (including BATT CHK).
 - A. Broken meter movement.
 - (1) Tip instrument rapidly from side to side. Meter needle should move freely and return to zero.
 - B. Electrical connection to meter is broken.
 - (1) Check all wires leading to meter and clean the contacts of quick-disconnects.
 - C. Battery is completely dead.
 - (1) Disconnect battery and check voltage with a volt-ohm meter.
 - D. If none of the above solves the problem, consult the factory.
2. Meter responds in BATT CHK position, but reads zero or near zero for all others.
 - A. Power supply defective.
 - (1) Check power supply voltages per Figure 11 of the HNU owner's manual. If any voltage is out of specification, consult the factory.
 - B. Input transistor or amplifier has failed.
 - (1) Check input connector on printed circuit board. The input connector should be firmly pressed down.
 - (2) Check components on back side of printed circuit board. All connections should be solid and no wires should touch any other object.
 - (3) Check all wires in readout for solid connections.

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ATTACHMENT H

SHIPPING

Since the OVA-128 contains hydrogen, it is subject to shipping restrictions.

As Personal Luggage

The OVA-128 can be taken on a plane as luggage, since a permit has been issued from the Department of Transportation to the manufacturer (Foxboro). Please refer to the original permit (Attachment 9) and the extended permit (Attachment 10).

Air Express

The following labels must be affixed to both sides of the OVA case when shipping OVA by Air Express.

- Danger - Peligro
- Flammable Gas
- Inside Container Complies with D.O.T. Regulations
- Hydrogen UN #1049
- Name and Address of Recipient

A hazardous air bill must be filled out. The following information is requested.

Proper Shipping Name	Hydrogen
Classification	Flammable Gas
I.D. No.	UN 1049
Net Quantity	75 Cubic Centimeters

In addition, the shipping's certification must be signed and marked CARGO AIRCRAFT ONLY.

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**ATTACHMENT I
D.O.T. EXEMPTION PERMIT**



**DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS
WASHINGTON, DC 20590
DOT-E 7607
(FIRST REVISION - CORRECTED COPY)**

DRAFT

1. Century Systems Corporation, Arkansas City, Kansas, is hereby granted an exemption from those provisions of this Department's Hazardous Materials Regulations specified in paragraph 5 below to offer packages prescribed herein of a flammable gas for transportation in commerce subject to the limitations and special requirements specified herein. This exemption authorizes the shipment of hydrogen in certain non-DOT specification cylinders as described in paragraph 7 below, and provides no relief from any regulation other than as specifically stated. Each of the following is hereby granted the status of a party to this exemption:

U.S. Department of Health, Education and Welfare, Rockville,
Maryland - PTE-1.

2. BASIS. This exemption is based on Century Systems Corporation's application dated March 10, 1978, submitted in accordance with 49 CFR 107.105 and the public proceeding thereon. The granting of party status is based on the following application submitted in accordance with 49 CFR 107.111 and the public proceeding thereon:

The U.S. Department of Health, Education and Welfare's application dated March 13, 1978.

3. HAZARDOUS MATERIALS (Descriptor and class). Hydrogen, flammable gas.
4. PROPER SHIPPING NAME (49 CFR 172.101). Hydrogen.
5. REGULATION AFFECTED. 49 CFR 172.101, 173.3.
6. MODE OF TRANSPORTATION AUTHORIZED. Passenger-carrying aircraft.
7. SAFETY CONTROL MEASURES. Packaging prescribed is a non-DOT specification seamless stainless steel cylinder of not more than 7.22 cubic inch water capacity; each cylinder to be pressure tested to at least 4000 psig, and charged to not more than 2100 psig at 70°F. The cylinder is a component part of a portable gas chromatograph.
8. SPECIAL PROVISIONS.
 - a. Each device must be shipped in a strong outside packaging as prescribed in 49 CFR 173.301(h).
 - b. A copy of this exemption must be carried aboard each aircraft used to transport packages covered by this exemption.
 - c. The pilot in command must be advised when the gas chromatograph is placed on board the aircraft.
 - d. The gas chromatograph must be appropriately secured.

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Continuation of 1st Rev. DOT-E 7607 corrected copy

DRAFT

9. REPORTING REQUIREMENTS. Any incident involving loss of contents of the package must be reported to the Office of Hazardous Materials Regulation as soon as practicable.

10. EXPIRATION DATE. May 1, 1980.

ued at Washington, D.C.:

Alan I. Roberts 9-7-78
(DATE)
Alan I. Roberts
Associate Director for
Hazardous Materials Regulation
Materials Transportation Bureau

Address all inquiries to: Associate Director for Hazardous Materials
Regulation, Materials Transportation Bureau, Research and Special Programs
Administration, Department of Transportation, Washington, D.C., 20590.
Attention: Exemptions Branch.

Dist: 3 of 2, FAA



DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
WASHINGTON, D.C. 20590

DOT-E 7607
(PTI)

In accordance with 49 CFR 107.111 of the Department of Transportation (DOT)
Hazardous Materials Regulations the party(s) listed below are granted the status of
party to DOT-E 7607.

The expiration date of the exemption is March 11, 1982 for the party(s) listed below.
This authorization forms part of the exemption and must be attached to it.

J. L. Roberts
Alan L. Roberts
Associate Director for
Hazardous Materials Regulation
Materials Transportation Bureau

13 JUN 1980
(DATE)

Dist: FAA

EXEMPTION HOLDER

Clayton Environmental Consultants, Inc.
Southfield, Michigan

Foxboro Company
Burlington, MA

APPLICATION DATE

December 5, 1979

March 24, 1980

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ATTACHMENT J

D.O.T. EXEMPTION PERMIT EXTENSION




U.S. Department
of Transportation
Research and
Special Programs
Administration

400 Seventh Street, S.W.
Washington, D.C. 20590

DOT-E 7607
(EXTENSION)

In accordance with 49 CFR 107.105 of the Department of Transportation (DOT) Hazardous Materials Regulations DOT-E 7607 is hereby extended by changing the expiration date in paragraph 10 from December 1, 1983 to September 1, 1985.

This extension applies only to party(s) listed below based on the application received in accordance with 49 CFR 107.105. All other terms of the exemption remain unchanged. This extension forms part of the exemption and must be attached to it.


Alan L. Roberts
Associate Director for
Hazardous Materials Regulation
Materials Transportation Bureau

OCT 27 1983
(DATE)

Dist: FAA

EXEMPTION HOLDER

Foxboro Company
South Norwalk, Ct.

APPLICATION DATE

September 16, 1983

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ATTACHMENT K

HYDROGEN RECHARGING

1. High grade hydrogen (99.999%) is required.
2. Connect the fill hose to the REFILL FITTING on the side Pack Assembly, with the FILL/BLEED valve in the OFF position.
3. Open H₂ supply bottle valve.
4. Place FILL/BLEED valve on fill hose in BLEED position momentarily to purge any air out of the system.
5. Crack the instrument TANK VALVE.
6. Open REFILL valve on instrument.
7. Place FILL/BLEED valve in FILL position until the instrument PRESSURE GAUGE equalizes with the H₂ SUPPLY BOTTLE PRESSURE GAUGE.
8. Shut REFILL valve, FILL/BLEED valve, and H₂ SUPPLY BOTTLE valve, in quick succession.
9. Turn FILL/BLEED valve to BLEED until hose pressure equalizes to atmospheric pressure.
10. Turn FILL/BLEED valve to FILL Position, then to BLEED position, then to OFF.
11. Close TANK on instrument.
12. Disconnect the FILL HOSE and replace protective nut on the REFILL FITTING.

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ATTACHMENT L

PARTICLE FILTER SERVICING

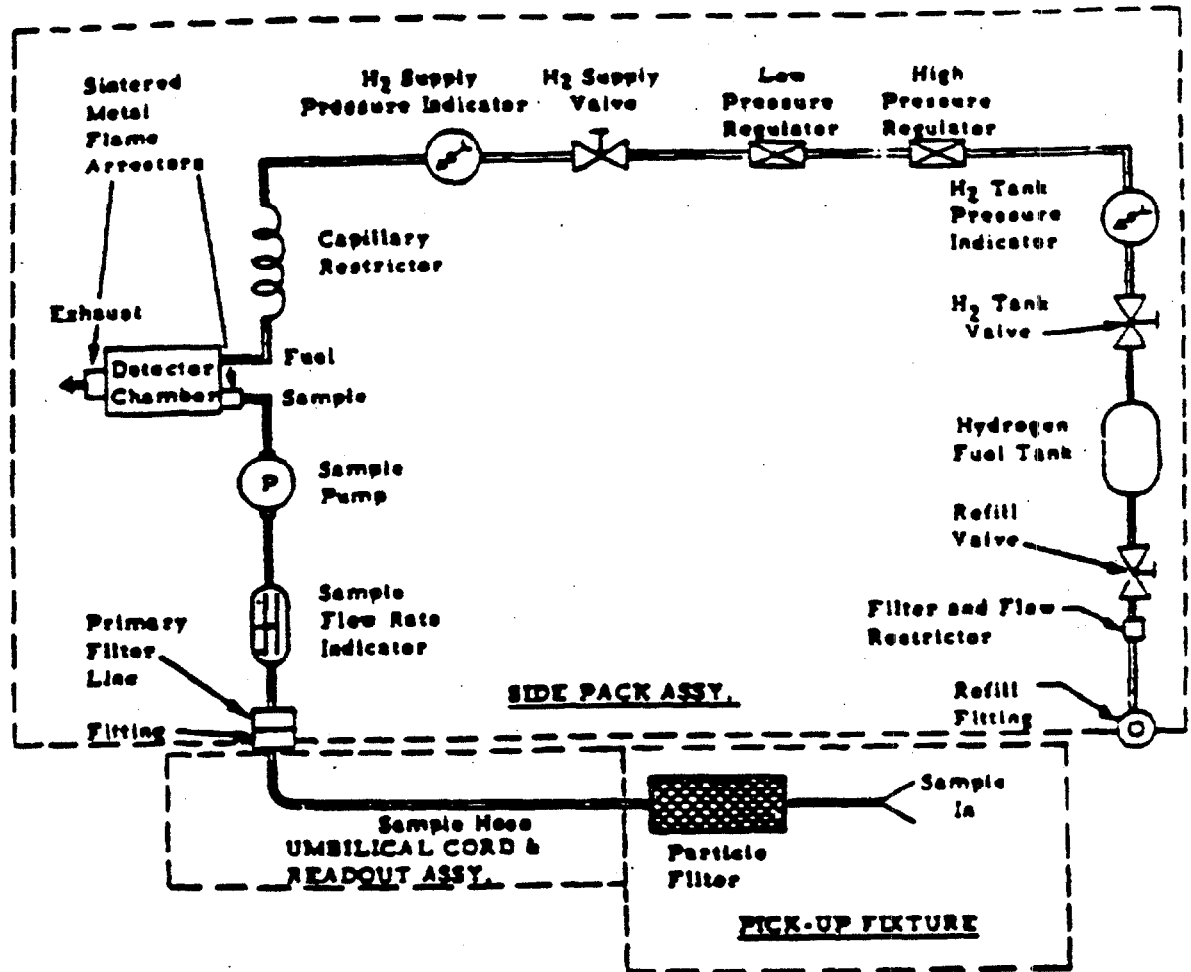
There are two points in the air sampling line of the OVA where filters have been placed to keep particulates from entering the instrument. The location of these filters are indicated on the figure in Attachment M. The first filter is located in the probe assembly and the second filter (primary filter) is located on the side pack assembly. Cleaning procedures are as follows:

1. Detach the probe assembly from the readout assembly.
2. Disassemble the probe (the components unscrew).
3. The particle filter located within the probe can be cleaned by blowing air through the filter.
4. Reassemble the probe.
5. The primary filter, located behind the sample inlet connector on the side pack assembly, is accessed by removing the sample inlet connector with a thin-walled 7/16 inch socket wrench. Remove the filter and clean as above.
6. Reassemble the sample inlet fitting and filter to the side pack assembly.
7. Check sample flow rate.

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ATTACHMENT M

FLOW DIAGRAM - GAS HANDLING SYSTEM





NUS
CORPORATION

**ENVIRONMENTAL
MANAGEMENT GROUP**

STANDARD OPERATING PROCEDURES

Number ME-04	Page 1 of 3
Effective Date 05/04/90	Revision 1
Applicability EMG	
Prepared Health and Safety	
Approved <i>D. Senovich</i> D. Senovich	

Subject

OXYGEN METER

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1.0 PURPOSE

2.0 SCOPE

3.0 GLOSSARY

4.0 RESPONSIBILITIES

5.0 PROCEDURES

5.1 INTRODUCTION

5.2 PRINCIPLE OF OPERATIONS

5.3 LIMITATIONS

6.0 REFERENCES

7.0 ATTACHMENTS

Subject OXYGEN METER	Number ME-04	Page 2 of 3
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1.0 PURPOSE

To establish procedures for the use of the oxygen meter.

2.0 SCOPE

Applies to usage of the oxygen meter by NUS/EMG personnel.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Instrument User - The user should be personally secure that he/she has been adequately trained and that he/she understands the operation and limitations of the oxygen meter. He/she is responsible to determine that the instrument is working properly prior to site usage.

5.0 PROCEDURES

5.1 INTRODUCTION

The oxygen content, in a confined space, is of prime concern to anyone about to enter that space. Removal of oxygen by combustion, reduction reactions, or displacement by gases or vapors is a hazard potential which response personnel must address. To accomplish this task, remote measurements must be made before anyone enters a confined space.

Portable oxygen indicators are invaluable when working in hazardous atmospheres. Terrain variations in the land and unventilated rooms or areas may contain insufficient oxygen to support life. When used properly, the portable oxygen indicator will read the percent oxygen in the immediate atmosphere. The normal ambient oxygen concentration is 20.8 percent.

Most meters have indicators which display the oxygen content from 0-25 percent. There are also oxygen meters available which measure concentration from 0-10 percent and 0-100 percent. The most useful range for response is the 0-25 percent oxygen content readout, since decisions involving air-supplying respirators and the use of combustible gas indicators fall into this range.

5.2 PRINCIPLE OF OPERATIONS

The oxygen indicator has three principle components for operation. These three components include the air flow system, the oxygen sensing device, and the microamp meter. Air is drawn to the oxygen detector with an aspirator bulb or pump. The oxygen detector uses an electrochemical sensor to determine the oxygen concentration in air. The sensor consists of: two electrodes, a sensing and a counting electrode; a housing containing a basic electrolytic solution; and a semipermeable Teflon membrane.

Oxygen molecules (O_2) diffuse through the membrane into the solution. Reactions between the oxygen and the electrodes produce a minute electric current, which is directly proportional to the sensor's oxygen content. This current passes through the electronic circuit. The resulting signal is shown as a needle deflection on a meter, which is usually calibrated to read 0-10 percent, 0-25 percent, or 0-100 percent oxygen.

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5.3 LIMITATIONS

The operation of oxygen meters depends on the absolute atmospheric pressure. The concentration of natural oxygen (to differentiate it from manufactured or generated oxygen) is a function of the atmospheric pressure at a given altitude.

At sea level, where the weight of the atmosphere above is greatest, more O₂ molecules are compressed into a given volume than at higher elevations. As elevation increases, this compression decreases, resulting in fewer O₂ molecules being "squeezed" into a given volume. Consequently, an O₂ indicator, calibrated at sea level and operated at an altitude of several thousand feet, will falsely indicate an oxygen-deficient atmosphere (less than 19.5 percent).

High concentrations of carbon dioxide (CO₂) shorten the useful life of the oxygen detector cell. Therefore, the unit can be used in atmospheres greater than 0.5 percent CO₂ only with frequent replacement or rejuvenation of the oxygen detector cell.

Although several instruments can measure an oxygen-enriched atmosphere (O₂ greater than 21 percent), no testing or other work should ever be performed under such conditions, because a spark, arc, or flame could lead to fire or explosion. Oxygen measurements are most informative when paired with combustible gas measurements. Together, they provide quick and reliable hazard data.

6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.



**ENVIRONMENTAL
MANAGEMENT GROUP**

STANDARD OPERATING PROCEDURES

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Applicability EMG	
Prepared Health and Safety	
Approved <i>[Signature]</i> D. Senovich	

Subject
COMBUSTIBLE GAS INDICATOR (CGI)

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- 1.0 PURPOSE**
- 2.0 SCOPE**
- 3.0 GLOSSARY**
- 4.0 RESPONSIBILITIES**
- 5.0 PROCEDURES**
 - 5.1 INTRODUCTION
 - 5.2 PRINCIPLE OF OPERATION
 - 5.3 OPERATING PROCEDURES
 - 5.4 LIMITATIONS AND APPLICATIONS
- 6.0 REFERENCES**
- 7.0 ATTACHMENTS**

Subject COMBUSTIBLE GAS INDICATOR (CGI)	Number ME-05	Page 2 of 5
	Revision 1	Effective Date 05/04/90

1.0 PURPOSE

To establish procedures for the use and maintenance of the combustible gas indicator.

2.0 SCOPE

Applies to usage of the combustible gas indicator (CGI) by NUS/EMG personnel.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Instrument User - The user should be personally secure that he/she has been adequately trained and that he/she understands the operation and limitations of the CGI instrument. He/she is further responsible to determine that the instrument has been calibrated according to the manufacturer's instructions and is working properly.

5.0 PROCEDURES

5.1 INTRODUCTION

The combustible gas indicator (CGI) is a type of flammable gas detector which is one of the first instruments to be used to survey a site. It measures the concentration of flammable vapor or gas in air, indicating the results as a percentage of the lower explosive limit (LEL) of the calibration gas.

The LEL of a combustible gas or vapor is the lowest concentration (by volume) in air which will explode, ignite, or burn when there is an ignition source. The upper explosive limit (UEL) is the maximum concentration of a gas or vapor which will ignite. Above the UEL, there is insufficient oxygen for the fuel level to support combustion. Below the LEL, there is insufficient fuel to support ignition.

5.2 PRINCIPLE OF OPERATION

Most combustible gas indicators operate on the "hot wire" principle. In the combustion chamber is a platinum filament that is heated. The platinum filament is an integral part of a balanced resistor circuit called a Wheatstone Bridge. The hot filament burns the combustible gas(es) on the immediate surface of the element, thus raising the temperature of the filament. Obviously, any single combustible gas or mixture of combustible gases will cause the meter to react. The effect of this trait must be understood by the CGI operator.

As the temperature of the filament increases so does its resistance. This change in resistance causes an imbalance in the Wheatstone Bridge. This imbalance is measured as the ratio of combustible vapor present compared to the total required to reach the LEL of the combustible gas used to calibrate the CGI. For example, if the meter reads 0.5, this reading means that 50 percent of the concentration necessary to create a combustible situation is present. If the LEL for the gas is 5 percent, then the meter indicates that a 2.5 percent concentration is present.

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If a concentration greater than the LEL and lower than the UEL is present, then the meter needle will stay beyond the 1.0 (100 percent) level on the meter. This indicates that the ambient atmosphere is readily combustible. When the atmosphere has a gas concentration above the UEL, the meter needle will rise above the 1.0 (100 percent) mark and then return to zero. This needle behavior occurs because the gas mixture in the combustion cell is too rich to burn. This condition permits the filament to conduct a current, just as if the atmosphere contained no combustibles at all. For this reason, it is very important to always watch the meter because this rapid deflection may be missed. This is a dangerous condition as expressed in Item 4 of Section 5.4.

5.3 OPERATING PROCEDURES

The following seven steps refer specifically to the MSA Explosimeter. CGIs sold by other manufacturers are similar, but the manufacturer's instructions must be consulted for changes.

Steps 1-4 shall be done in an uncontaminated atmosphere, as follows:

1. Attach sampling line and probe to the instrument.
2. Lift the rheostat on/off bar and turn the bar 1/4 turn clockwise. The meter pointer should move rapidly upscale and then return to zero or less.
3. Flush fresh air through the instrument by squeezing the aspirator bulb 5 times. Other instruments may have an internal-powered pump.
4. Adjust the rheostat knob until the meter pointer rests at zero. Taping the knob in the zeroed position will help to prevent its being jarred off zero while in use.

Steps 5-7 are done onsite, as follows:

5. Place the end of the sampling line or probe at the point where sampling is to occur.
6. Aspirate the sample through the instrument until the highest reading is obtained. Five squeezes of the bulb are usually enough to give maximum deflection. Two additional squeezes are required for each added length of sampling line.
7. Do not turn the instrument off until you have left the atmosphere being tested and you have flushed the instrument with fresh air.

5.4 LIMITATIONS AND APPLICATIONS

The following shall apply:

1. The CGI shall be used in conjunction with an oxygen meter.
2. The instrument shall not be used in an oxygen-deficient atmosphere. In this situation, the atmosphere does not contain enough O₂ to support combustion; however a slight increase in O₂ may make the atmosphere extremely combustible.
3. The instrument shall not be used in an O₂-enriched environment because of the explosive nature of oxygen. This includes mixtures of oxygen with hydrogen or acetylene.

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4. Be sure to watch the meter continuously while aspirating a sample. If the needle pegs and then returns to zero, the indication is that the atmosphere is either O₂-deficient or that combustible vapors exceed the UEL, creating a very explosive situation. In the second case, the danger is that an O₂ increase can create an explosive mixture.
5. When measuring, take readings with the probe held at ground, waist, and overhead positions to ensure detection of vapors, whose densities are greater or lesser than that of air. When inside a building or confined space, take special care to measure high, low, and middle positions and particularly check out room corners and other restricted areas, where explosive vapors could become trapped.
6. Do not use in atmospheres other than air. It is not capable of measuring the percentage of vapors in steam or other gaseous atmospheres.
7. The CGI will not indicate the presence of explosive or combustible mists or sprays, such as lubrication oil or explosive dusts, like grain or coal dusts.
8. Do not draw liquids into this unit. Be careful when sampling over drums, pools, etc.
9. The following substances may "poison" the detection filament: fuming acids, leaded gasoline, silanes, silicones, silicates and other silicon-containing components. Even minute quantities of these substances will cause inaccurate responses. When it is suspected that these substances have been aspirated, the instrument shall be checked with a calibration kit.
10. The relative humidity must be in the range of 10-90%. Weather information can be obtained from the Weather Service, a local airport, or the radio.
11. Do not switch the instrument on/off unless in a known combustible-free atmosphere.
12. When the batteries begin to become drained, the instrument will give sluggish responses.
13. In very cold temperatures, the batteries will drain much faster because more energy is required to heat the platinum filament.
14. In very warm temperatures, in excess of 125°F, condensation may cause erroneous readings.
15. The explosive limits for most gases and vapors are well above the TLVs for those substances.
16. High-boiling-point combustible solvents, which are tested at normal ambient temperatures, will show a relatively low vapor concentration. If the temperature of the solvent is increased, the increased concentration of vapors may become combustible.
17. High-boiling-point combustible solvents, which are sampled in areas warmer than the instrument, may be expected to form some condensation in the sampling line and flow systems; as a consequence the concentration may read lower than it actually is in the sampling environment.
18. The CGI meter reads only from 0 to 100% of the calibration gas (often either methane or propane) LEL. Therefore, when another combustible gas is detected, the exact meter reading is not correct or reliable. To provide an additional safety factor, field crews shall not work where combustible gas is measured above 25% of the LEL for a methane- or propane-calibrated CGI.

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6.0 REFERENCES

None.

7.0 ATTACHMENTS

None.

ATTACHMENT D-III
GRUMANN EMERGENCY RESPONSE
CONTINGENCY PLAN

VII. CONTINGENCY PLAN

The drum storage facility for which this Contingency Plan has been prepared is located northeast of the Main Gate, as shown in Figure No. 1 (map pocket). It is approximately fifty (50) feet by eighty (80) feet with a curbed concrete floor draining to a fifty (50) cubic foot sump, a corrugated aluminum roof and wall panels, with a ten (10) foot by ten (10) foot doorway. It is designed for single level storage of up to 250 fifty-five gallon steel drums. The following hazardous materials will be stored in this area:

- Waste Halogenated Solvents
- Waste Non-Halogenated Solvents
- Waste Paint Residue
- Waste photographic chemicals (silver, cadmium)
- Miscellaneous characteristic wastes

1. Purpose of Plan

This plan was designed by Grumman Aerospace Corporation to minimize hazards to human health and the environment from fires, explosions or any unplanned, sudden or non-sudden release of hazardous waste constituents to the air, soil or surface water.

The provisions of this plan will be carried out immediately whenever there is a fire, explosion or release of hazardous waste or hazardous waste constituents which could threaten human health or the environment.

Table VII-1 is a listing of emergency notification phone numbers.

2. Emergency Coordination

Implementation of the provisions of the Contingency Plan will be the responsibility of the Emergency Coordinator.

Table No. VII-1

EMERGENCY NOTIFICATION PHONE NUMBERS

Emergency Coordinators

George H. Busch	(516) 234-2380 (home) (516) 953-6722 (office)
James K. Lewis	(516) 475-8664 (home) (516) 953-6724 (office)
Charles Smith	(516) 588-3992 (home) (516) 953-6716 (office)
Kenneth Swicicki	(516) 399-4020 (home) (516) 953-6716 (office)
Barry Andres	(516) 567-4526 (home) (516) 575-2029 (office)
Riverhead Police Department	(516) 727-4500
Manorville Fire Department	(516) 924-5252*
Central Suffolk Hospital	(516) 548-6200 (emergency room) (516) 548-6000 (general information)
National Emergency Response Center	(800) 424-8802
NYS Spill Notification	(518) 457-7362
Suffolk County Dept. of Health Services Spill Notification	(516) 360-5555
NYSDEC - Regional Engineer	(516) 751-7900

* Note: This telephone number is actually for the Fire Center in Yaphank which is responsible for sounding the fire alarm.

The Emergency Coordinator will be notified by the Security Duty Officer on watch when the emergency occurs. The Emergency Coordinator will determine if the emergency involves hazardous wastes or hazardous waste facilities and will be responsible for contacting the following, as required:

GAC Crash Crew
Manorville Fire Department
Riverhead Police Department
Central Suffolk Hospital

The Crash Crew is the initial group to respond in the event of a fire. It maintains water, carbon dioxide and halon extinguishers and AFFF foam trucks. Since Grumman's on-site security fire brigade and emergency medical personnel would be responding to all emergencies, it is not anticipated that outside services would be required. However, copies of this Contingency Plan have been sent to the Manorville Fire Department, Riverhead Police Department and Central Suffolk Hospital to familiarize them with our procedures.

The Emergency Coordinator is familiar with all operations and activities at the facility, the location and characteristics of hazardous wastes on-site and has the authority to commit the resources necessary to implement this plan. Material Safety Data for Trichloroethane, Methyl Ethyl Ketone, Methyl Isobutyl Ketone, Methylene Chloride, Toluene and Phenol is provided at the end of this Contingency Plan for ease of reference.

The following is a list of personnel who are qualified to act as Emergency Coordinator and includes personal telephone numbers. The list is organized in the order in which the personnel should be contacted:

George H. Busch
159 Bridge Rd.
Hauppauge, NY 11788
Home - (516) 234-2380
Office- (516) 953-6722

James K. Lewis
179 Grove Ave.
Patchogue, NY 11772
Home - (516) 475-8664
Office- (516) 953-6724

Charles Smith
9 Laurel Road
Lake Ronkonkoma, NY 11779
Home - (516) 588-3992
Office - (516) 953-6716

Kenneth Swicicki
88 Cranford Blvd.
Mastic, NY 11950
Home - (516) 399-4020
Office - (516) 953-6716

Barry Andres
42 Bartley Lane
West Sayville, NY 11796
Home - (516) 567-4526
Office - (516) 575-2029

A copy of this list is available in the Security Office at all times and is updated regularly. Business phone numbers for the above personnel are available in the Grumman Phone Directory, a copy of which is in the Security Office and is available at numerous locations throughout the Facility.

3. Emergency Procedures

- A. In event of a fire, explosion or release of hazardous waste material or hazardous waste constituents, the person witnessing the incident must immediately call the Plant Security emergency number and notify the Duty Officer of the location and nature of the emergency.

NOTE:

- o All Grumman Telephone Directories have emergency call numbers on the rear cover.
 - o All Grumman Telephones have the emergency call number on the phone cradle.
- B. The Security Duty Officer will immediately notify the Grumman Crash Crew and the personnel on the Emergency Coordinator list.
- C. If an imminent or actual emergency exists and evacuation of Facility personnel is warranted, evacuation may be signaled by the Security Duty Officer, or the Emergency Coordinator using the public address system, telephone or direct voice call. For details on evacuation see Section 5 - Evacuation Plan.
- D. The Emergency Coordinator will further investigate the emergency to identify the character, source, amount and areal extent of released materials. The investigation will include on-site observation, review of inventory records, operating records and other sources to identify waste materials and, if necessary, the collection and analysis of samples.
- E. The Emergency Coordinator will assess the potential of direct and indirect hazard to human health and the environment. Some of the factors to be considered include the potential generation of toxic gasses, contaminated water runoff as a result of fire fighting measures, and the proximity of populated areas.
- F. If the Emergency Coordinator determines that the emergency could threaten human health or the environment outside the facility then the following steps must be taken:
- o Contact Mr. John Ohlmann, Director of Environmental Protection, home number (516) 757-2586; office phone number (516) 575-2385.

- o If assessment indicated evacuation of local area may be advisable, contact appropriate local authorities (Police, Fire Department and Emergency Rescue Squads).
 - o The Emergency Coordinator will make himself available to the local authorities to inform them of the extent of the danger and assist them in evaluating the need for evacuation.
 - o Immediately notify the National Emergency Response Center (NERC) at 800/424-8802; the New York State 24 - hour oil and hazardous materials spill notification number 518/457-7362 and the Suffolk County Department of Health Services spill notification number (516) 360-5555. Be prepared to report the following information:
 - Name and telephone number of reporter;
 - Name and address of facility;
 - Time and type of incident;
 - Name and quantity of material(s) involved, to the extent known;
 - Extent of injuries, if any; and
 - Possible hazards to human health and environment, outside the facility.
- G. During the emergency, the Emergency Coordinator will take all reasonable measures necessary to insure that fires, explosion, and releases of hazardous waste materials do not occur, reoccur or spread to other active areas of the hazardous waste facility. These measures will include, where applicable, suspending impacted plant processes and operations, collecting and containing released waste and removing or isolating containers. If a container is not in good condition, or if it begins to leak, the hazardous waste in that container should be transferred to a container that is in good condition. Should this not be possible, it will be managed in such a manner that there will be no leakage of hazardous waste to the environment.

- H. If the facility suspends operations in response to the emergency, the Emergency Coordinator will monitor leaks, and damage to other equipment, wherever it is appropriate.
- I. Immediately following an emergency, the Emergency Coordinator will provide for treating, storing, or disposing of recovered waste, contaminated soil or any other material that results from a release, fire or explosion at the facility. These materials will be stored in empty drums obtained from stock or an off-site vendor. Since spills would be contained in the sump and runoff will not be a problem, time is available to obtain additional drums if required.
- J. Prior to resuming operations at the affected area of the facility, the Emergency Coordinator will ensure that:
 - a. All emergency equipment listed in Section IV of this Plan will either be disposed of or washed appropriately, and rinse water disposed of accordingly.
 - b. Any water generated in the emergency response or cleanup will be handled as an unknown waste (see Section III - Waste Analysis Plan). If the analysis shows that the waste is acceptable for treatment in the Industrial Wastewater Treatment Plant (IWTP) the waste will be transported to the IWTP. Wastes not suitable for this on-site treatment will be properly disposed of off-site.

4. Emergency Equipment

Table VII-2 is a listing of emergency equipment available at this facility.

A. Spill Control

The following materials are stored in the Chemical Storage Room of the Industrial Waste Treatment Facility:

Table VII-2

**GRUMMAN AEROSPACE CORPORATION
HAZARDOUS WASTE MANAGEMENT
CALVERTON**

List of Emergency Equipment

<u>Equipment</u>	<u>Amount</u>	<u>Location</u>	<u>Function</u>	<u>Capability</u>
<u>A. Spill Control</u>				
Sodium Bicarbonate	4x100 pounds	IWTP	Neutralize Acids	Used for all acid spills
Sodium Bisulfate	400 pounds	IWTP	Neutralize Bases	Used for all base spills
Absorbent Pads	1 bag	IWTP	Spill Cleanup	Used as an absorbant to aid in spill cleanup of any drummed waste
Lime	2x50 pounds	IWTP	Neutralize Acids	Used for all acid spills
Bentonite Absorbent	4x50 pounds	Drum Storage Bldg.	Spill Control	Used to contain spills of any drummed waste
Speedi-Dry	4x50 pounds	Drum Storage Bldg.	Spill Cleanup	Used as an absorbant to aid in spill cleanup of any drummed waste
<u>B. Personal Protective</u>				
Respirator	1 per indiv.	Individual's Possession	Respiratory Protection	Protection from all vapors potentially encountered in spills

Table VII-2 (Continued)

<u>Equipment</u>	<u>Amount</u>	<u>Location</u>	<u>Function</u>	<u>Capability</u>
Full Face Mask	1 per indiv.	Individual's Possession	Splash Protection	Protection from chemical splashes
Goggles	1 per indiv.	Individual's Possession	Splash Protection	Protection from chemical splashes
Chemical Resistant Splash Suit	1 per indiv.	Individual's Possession	Splash Protection	Protection from chemical splashes
Boots	1 pair per indiv.	Individual's possession	Foot Protection	Protection from chemical spills/splashes
Gloves	1 pair per indiv.	Individual's Possession	Hand Protection	Protection from chemical spills/splashes
C. <u>Fire Fighting Equipment</u>				
CO ₂ Extinguisher	1x100 pound	Drum Storage Bldg.	Fire Fighting	Suitable for extinguishing any small fire in drum storage bldg.
Crash Crew Vehicles Halon Supplied	4	Fire House	Fire Fighting	Suitable for fighting major fires
Foam Supplied	3	Fire House	Fire Fighting	Suitable for fighting major fires

Table VII-2 (Continued)

<u>Equipment</u>	<u>Amount</u>	<u>Location</u>	<u>Function</u>	<u>Capability</u>
D. <u>Communication</u>				
Telephone	1	IWTP	Telephone Communication	On-site and off-site communication. Contact emergency response organizations
Two-Way Radio	1	IWTP/ Portable	Emergency Communication	Twenty-four hour direct contact with Security Office and/or Air Field Control Tower
E. <u>Spill Containment</u>				
Empty Drums	100-140 empty drums	Immediately west of drum storage facility	Concrete Pad (approx. 30' x 80') for storage of empty 55 gallon drums	For use in containing materials collected from hazardous waste spills splashes, etc.

4/100 pound bags of sodium bicarbonate
400 pounds of sodium bisulfate
1 bag of absorbent pads
2/50 bags of lime

The following materials are stored in the Drum Storage Facility:

4/50 pound bags of Bentonite Absorbent
4/50 pound bags of Speedi-Dri

B. Personal Protective

Each drum storage facility employee has a personal duffel bag at his place of work which contains a respirator, goggles, full face mask, chemical resistant splash suit, boots and gloves.

C. Fire Fighting Equipment

Fires will be handled by Grumman's Crash Crew and/or the Manorville Fire Department.

D. Communications and Alarm Systems

All employees can be contacted by a public address system. There is also an intercom system for contacting all departments. A two-way radio is used by workers in the drum storage building. This radio allows these workers to be in contact with the Security Office which is manned 24 hours a day.

5. Evacuation Plan for the Drum Storage Facility

- A. Evacuation will be signaled by voice call directly to personnel involved.
Due to the small size of the drum storage building (fifty [50] feet by eighty [80] feet) the use of a public address or similar system is not necessary.
- B. In the event of a fire, explosion or other incident which would threaten the safety of operating personnel:

- All personnel should exit the building by the entrance doorway
- The secondary exit is the one foot, six inch (1'-6") opening provided around the perimeter of the facility between the top of the curb and the bottom of the side panel.

6. Reporting Requirements

- A. Following a fire, explosion or release of hazardous waste to the environment and before operations at the affected areas of the facility are resumed, Grumman Corporation will notify the Commissioner, New York State Department of Environmental Conservation and appropriate local authorities that the facility is in compliance with 6NYCRR Part 373-2.4(g)(8).
- B. Within 15 days of the incident Grumman Corporation will submit a written report on the incident to the Commissioner of the NYSDEC. The report will include the following:
 - Name, address and telephone number of the facility;
 - Name and telephone number of the contact person on the incident
 - Name and quantity of materials involved;
 - The extent of injuries, if any;
 - An assessment of actual or potential hazards to human health or the environment where applicable; and
 - Estimated quantity and disposition of recovered material that resulted from the incident.

7. State and Local Authorities

- A. Commissioner
New York State Department of Environmental
Conservation
50 Wolf Road
Albany, New York 12233
Telephone Number: 518/457-6610

- B. Regional Engineer
NYS Department of Environmental Conservation
Region I - Building 40 - SUNY
Stony Brook, New York 11794
Telephone Number: 516/751-7900
- C. Suffolk County Department of Health Services
225 Rabro Drive East
Hauppauge, New York 11787
Telephone Number: 516/348-2786
- D. Manorville Fire Department
Silas Carter Road
Manorville, New York 11949
Telephone Number: 516/878-6614
- E. Riverhead Police Department
210 Howell Ave.
Riverhead, New York 11901
Telephone Number: 516/727-4500
- F. Central Suffolk Hospital
1300 Roanoke Avenue
Riverhead, New York 11901
Telephone Number: 516/548-6200 (emergency room)
516/548-6000 (general information)

8. Procedures for the Storage of PCBs

- All PCB spills involving 10 lbs. or more of PCB material must be reported to National Response Center (1-800-424-8802) and the NYSDEC Regional Office.

- Mineral oil that is assumed or known to contain at least 50 ppm PCB must not be mixed with mineral oil that is known or assumed to contain less than 50 ppm PCB's to reduce the concentration of PCB. If dielectric fluid from untested, oil-filled circuit breakers, reclosers or cable is collected in a common container with dielectric fluid from other oil-filled electrical equipment, the entire contents of the container must be treated as PCB's with a concentration of at least 50 ppm. If any PCB's at a concentration of 500 ppm or greater have been added to a container, the total container contents must be considered as having PCB concentration of 500 ppm or greater for disposal requirements.
- At the completion of a PCB spill clean-up, Grumman should document the clean-up with records and certification of decontamination. These documents must be maintained at the facility for a period of five (5) years. The records and certification should address the following:
 1. Identification of the source of the spill,
 2. Estimated or actual date and time of the spill occurrence,
 3. The date and time clean-up was completed,
 4. A brief description of the spill,
 5. Pre-clean up sampling data used to establish the spill boundaries,
 6. A brief description of the solid surfaces cleaned and the double wash-rinse method used,
 7. Approximate depth of soil excavation and the amount of soil removed,

8. A certification of statement signed by the facility manager or environmental engineer stating that the clean-up requirements have been met and the information contained in the record is true to the best of his knowledge, and
9. Post clean-up sampling.

PCB clean-up/decontamination operation should include the following:

1. Where a spill directly contaminates surface waters, sewers or drinking water supplies, it should be reported to EPA Regional Office (the Office of Pesticides and Toxic Substance Branch) and obtain guidance for appropriate clean-up within 24 hours after discovery.
2. In the absence of visible traces, the spill boundaries should be established by sampling schemes.
3. Solid surfaces must be double washed/rinsed with solvents (solvents in which PCB's are soluble to an extent of at least 5 percent). The area must be cleaned to 10 micrograms per 100 square centimeters as established by standard commercial wipe tests.
4. All soil within the area (i.e., visible traces of soil and a buffer of one (1) lateral foot around the visible traces), must be excavated and the ground be restored to its original configuration by back filling with clean soil (i.e., soil containing less than 1 ppm PCB's). These spill clean-up works should be completed within 48 hours after reporting.
5. Outdoor spill clean-up of solid surfaces should be carried out to a PCB concentration of 100 micrograms per 100 square centimeter.

6. For soil contamination, the clean-up should be done to a PCB concentration of 25 ppm in restricted access areas and for non-restricted access areas 10 ppm of PCBs by weight provided that the soil is excavated to a minimum depth of ten (10) inches and the excavated soil is replaced with soil containing less than 1 ppm PCBs.
7. Post clean-up sampling should be done in accordance with "Field Manual for Grid Sampling of PCB Spill Sites to Verify Clean Up" (EPA 560/5-86.017, May 1986)."

9. Material Safety Data

Material Safety Data is provided for Trichloroethane, Methyl Ethyl Ketone Methyl Isobutyl Ketone, Methylene Chloride, Toluene, and Phenol on the following pages.

RCRA Facility Investigation Community Relations Plan

for

Naval Weapons Industrial Reserve Plant

Calverton, New York



**Northern Division
Naval Facilities Engineering Command**

Contract Number N62472-90-D-1298

Contract Task Order 0090

July 1993

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1.0 INTRODUCTION

This Community Relations Plan (CRP) will discuss public involvement activities related to the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) of the Naval Weapons Industrial Reserve Plant (NWIRP) site in Calverton, Long Island. This work is being performed by HALLIBURTON NUS under Contract N62472-90-D-1298, Contract Task Order #0090. The goal of the CRP is to develop an understanding of the community's perspective of the site and to keep the community involved and informed of the progress of the RFI. The objective of the RFI is to characterize the nature and extent of environmental contamination and the potential risks to human health and the environment.

The CRP has three objectives: to set up channels for communicating information to the public, to provide opportunities for citizens to express their concerns, and to solicit input from the public. The CRP identifies mechanisms to facilitate the communication of necessary technical information and concerns between the Navy and the public in an effort to help the community fully understand the progress and results of the RI. It is important to understand that the CRP should be dynamic to reflect the technical progress of the site investigation while being flexible enough to meet the needs and concerns of the community. Because of this, the CRP must periodically be reviewed and revised.

The CRP outlines the objectives of community relations activities and presents the techniques which will be used to meet those objectives. A standard CRP includes a summary site description, background site history and community relations history, any issues and concerns voiced by the community, community relations objectives, and the techniques which will be used to meet those objectives. The CRP generally outlines a preliminary schedule of activities, defines roles and responsibilities for plan implementation, and lists interested and affected parties.

2.0 SITE BACKGROUND

2.1 OVERVIEW

The Naval Weapons Industrial Reserve Plant (NWIRP) at Calverton is located in Suffolk County, New York (Figure 2-1). The plant is located on Long Island, New York, and is operated for the U.S. Navy by Grumman Corporation. NWIRP Calverton covers approximately 6,000 acres, most of which is in the Town of Riverhead. The remaining part of the property is in Brookhaven.

The facility is roughly rectangular in shape. On the north, it is bounded by Route 25 (Middle Country Road). Wading River and Manor Road border the facility to the west, and River Road and Grumman Boulevard border it to the south. A spur of the Long Island Railroad runs inside the central third of the facility's southern perimeter and up into the center of the facility above the main gate. East of the facility is agricultural land (Figure 2-2).

The mission of NWIRP Calverton is to assemble, test, flight test, refit, and retrofit Naval aircraft. The facility supports aircraft design and production at NWIRP Bethpage (located in the Town of Oyster Bay in Nassau County). The NWIRP Calverton facility includes hangar space, testing sites, and other production and industrial related facilities. There are two runways: the first is 7,000 feet long, and the second is 10,000 feet long.

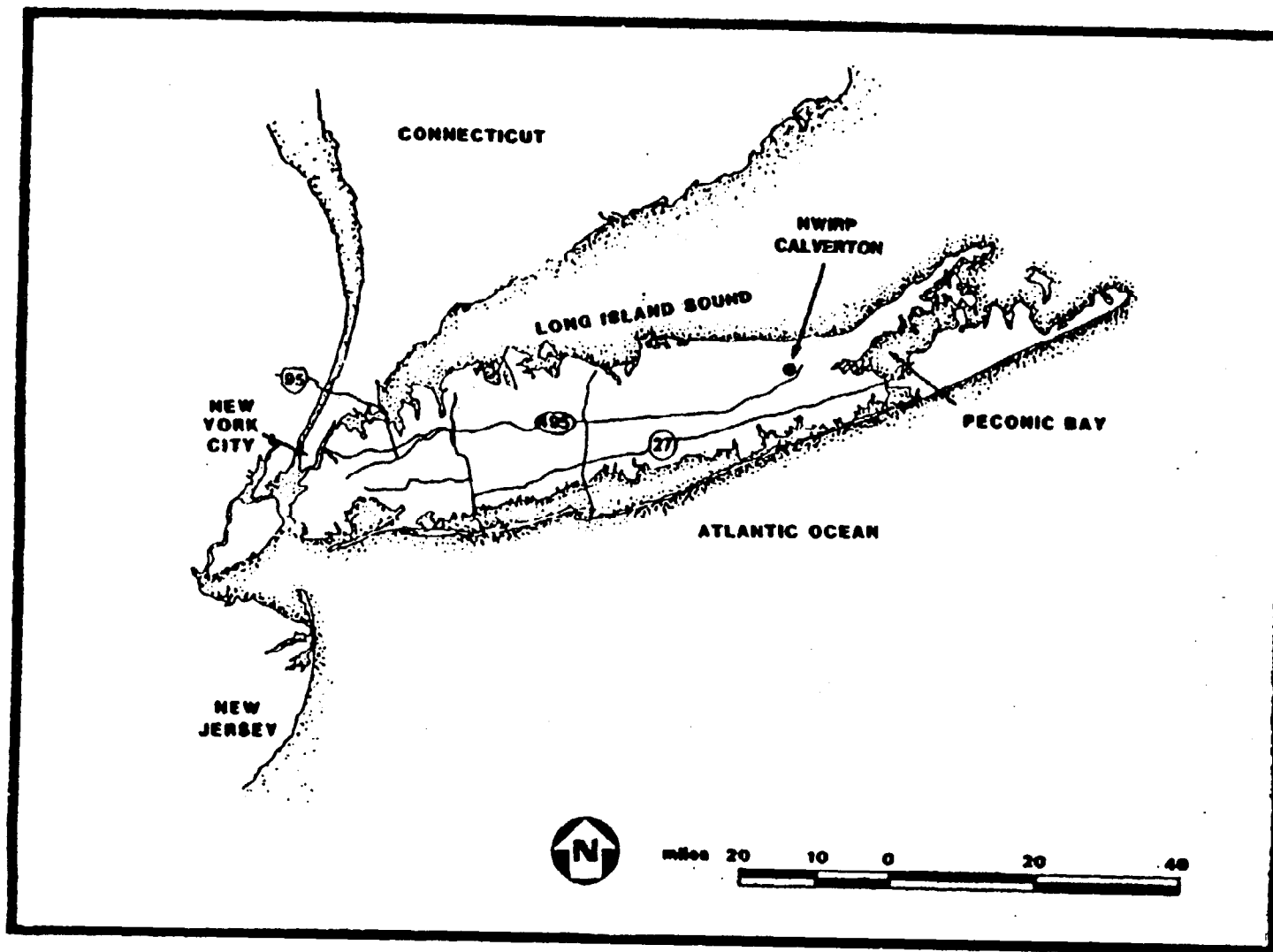
2.2 HISTORY

NWIRP Calverton was built during the Korean War; construction was completed in 1954. Production, testing and upgrades to Naval aircraft started at NWIRP Calverton in the era of military fighter jets such as the Cougar, Panther, Jaguar, and Tiger. Amphibious aircraft and anti-submarine aircraft were also produced at the facility. In the late 1960's, testing of the lunar module used in all of the U.S. lunar landings began at NWIRP Calverton. A special outdoor testing facility was constructed to simulate lunar conditions for this type of testing.

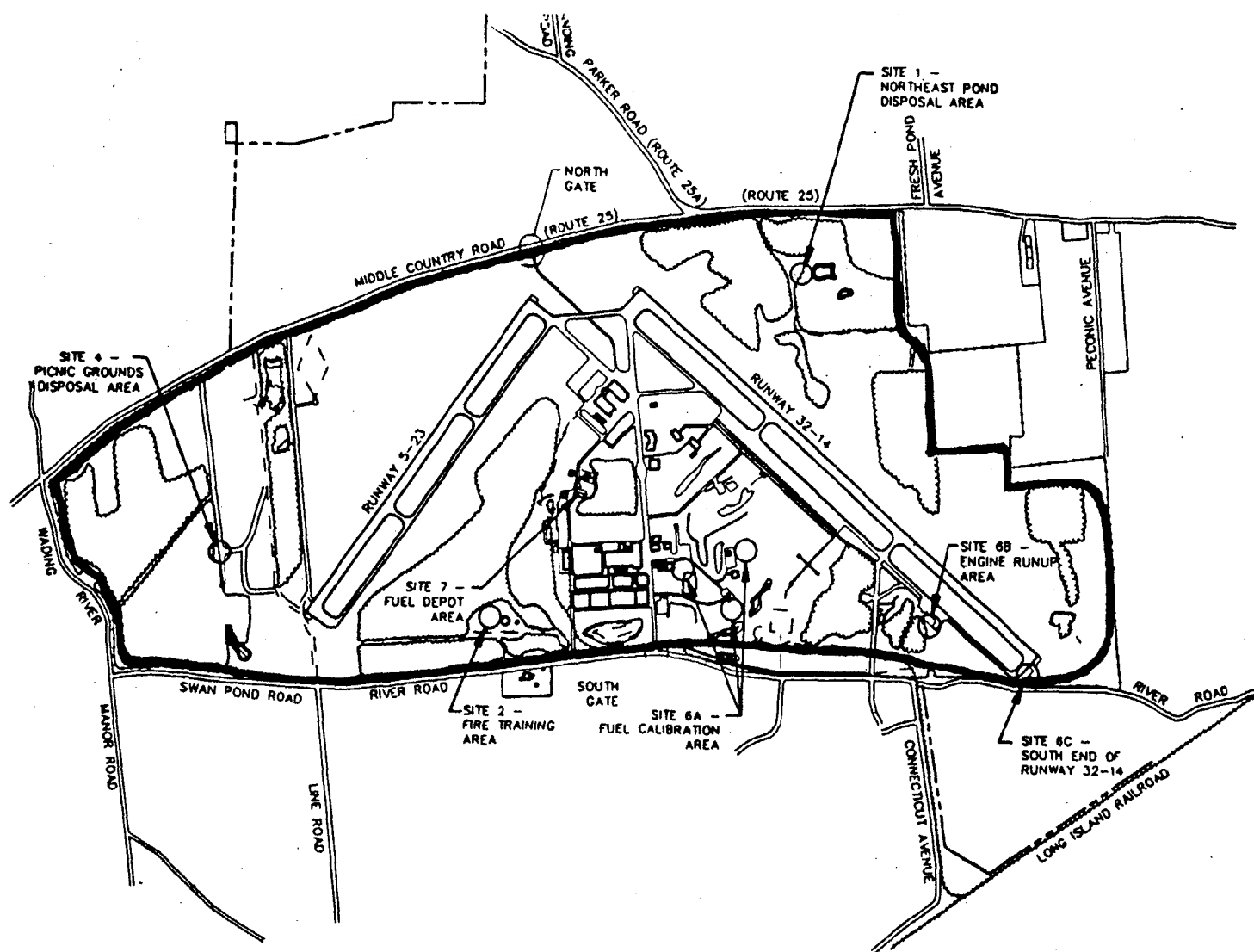
In 1974, a modernization plan for NWIRP Calverton was submitted to the Navy. Future development of NWIRP Calverton was placed on hold because of the urgent need for a new 1,000-acre national cemetery to replace the one at Farmingdale, New York.

In the late 1970's, modifications to Navy aircraft continued to be performed at NWIRP Calverton facilities. New aircraft worked on during this period included the F-214, TC-4C, and EF-111A. In the early 1980's, a new Joint

Figure 2-1



GENERAL LOCATION MAP
NWIRP, CALVERTON, NEW YORK



FACILITY LAYOUT MAP
NWIRP, CALVERTON, NEW YORK

0 2000 4000
SCALE IN FEET

E-7

Figure 2-2

Safety Review Board was created to oversee NWIRP Calverton operations; the board consisted of contractors operating the facility. Also at this time, production of the new Super Tomcat and the X-29A forward-swept-wing aircraft began.

2.3 FACILITY OPERATIONS

NWIRP Calverton is a government owned/contractor operated (GOCO) facility and falls under the cognizance of Naval Air Systems Command. The Defense Logistics Agency (DLA) provides on-site administration and acts as the Department of Defense's liaison with Grumman Corporation, the facility operator. In total, the facility covers 11 square miles, most of which is owned by the Navy. The Avionics Test Building (Plant 08) and its guard booth are the only structures located on land owned by Grumman.

2.3.1 U.S. Navy

The Navy's Installation Restoration (IR) Program provides the authority to conduct the remedial investigation underway at NWIRP Calverton. The IR Program is designed to identify contamination of Navy and Marine Corps facilities and lands resulting from past operations and to institute corrective measures. All facility investigations at NWIRP Calverton will be conducted in compliance with the Resource Conservation and Recovery Act (RCRA).

The Navy is currently in the RCRA Facility Investigation (RFI) phase under the IR Program. The RFI portion consists of gathering and analyzing technical data in an effort to understand the nature and extent of contamination and evaluate risks to human health and the environment. The RFI assesses contamination by collecting samples of various media including: soil-gas, soil, sediments, surface water, and groundwater. Following the RFI, the Corrective Measures Study (CMS) will evaluate corrective measures alternatives. The next step in the process is the implementation of the chosen corrective measures.

The New York State Department of Environmental Conservation (NYSDEC) is the lead regulatory agency of NWIRP Calverton. NYSDEC and the Navy are working together in the effort to comply with state laws and regulations.

2.4 HISTORY OF INVESTIGATIONS

In 1986 an Initial Assessment Study (IAS) (RGH 1986) was conducted for NWIRP Calverton. The purpose of the IAS was to identify and assess areas of concern posing a potential threat to human health or to the environment due to contamination from past hazardous material operations. Based on historical records, aerial photographs, field inspections, and personnel interviews, six potentially contaminated areas were identified. Since this study, a seventh area has been identified and will be considered for investigation. These seven areas are as follows:

- Site 1 - Northeast Pond Disposal Area
- Site 2 - Fire Training Area
- Site 4 - Picnic Grounds Disposal Area
- Site 6a - Fuel Calibration Area
- Site 6b - Engine Runup Area
- Site 6c - South End of Runway 32-14
- Site 7 - Fuel Depot Area

A field investigation was conducted by HALLIBURTON NUS in 1991 during which confirmation samples were collected to evaluate the potential for contamination at each site. The field investigation included collection and analysis of soil, sediment, surface water, and/or groundwater samples. In April 1992, the final Site Investigation Report (SI) was issued (HALLIBURTON NUS, 1992). This report summarized the finding of the field investigation, and based on these findings, provided the following recommendations.

- Quantify the nature and extent of contamination of the soils and groundwater at Sites 1, 2, 6A (except the engine runup area and engine test house) and the surface water and sediment at Site 1.
- Quantify the risks to human health and the environment associated with contamination in these areas.
- Investigate the potential for contamination to be present at other areas, including the former coal storage pile and the former leach fields. The source of freon-contamination of the production wells at the facility has not been identified.

- No additional investigation is required for Site 4, the engine runup area and engine test house at Site 6A, 6B, and Site 6C.

Since the time of the SI, NYSDEC has found groundwater contaminated with volatile organics offsite, but near, NWIRP Calverton. The state has identified the Electronic Counter Measures (ECM) area at the facility as being the possible source of this contamination. The Navy has responded by initiating an RFA-Sampling Visit Work Plan at the ECM area to determine if this could be a possible source area.

A summary of PA/SI conclusions and recommendations is shown in Table 2-1. This table describes which sites proceeded to the next stage in the investigation, contaminants of concern, and media.

2.4.1 Current Investigations

In April 1992, NYSDEC issued Grumman a Hazardous and Solid Waste Amendment (HSWA) Permit (Number NYD003995198). In part, Grumman and the Navy were awaiting direction from the NYSDEC as to whether the investigations at the site should proceed under the RCRA or CERCLA route. On July 28, 1992, the state informed the Navy that the investigations should proceed under the RCRA program.

Site 1 - Northeast Pond Disposal Area (Figure 2-3)

Until 1984, the northeast pond disposal area was used primarily for the disposal of demolition debris such as concrete, brick, wood, and other construction materials. A final soil cover was placed over the disposed material in 1984. According to available information, other materials in the fill include aircraft sections and junked aircraft assembly tooling, office materials and furniture, pallets, and paint cans. The wreckage of several aircraft may be present in the area. It is reported in the 1986 Initial Assessment Study (IAS) (RGH, 1986) that any of the following wastes may be present at the sites: petroleum, oils and lubricants (POLs), asphalt paving material, halogenated and non-halogenated solvents, and paint sludge.

The waste materials were placed in a depression adjacent to the pond, and may have been used to fill portions of the pond. Soil borrowed from an adjacent hillside was used to cover the material. According to the IAS, approximately 7,500 cubic yards of material may have been disposed in this area.

Table 2-1 Summary of PA/SI Conclusions and Recommendations

	PA Recommendation for SI	SI/RFA-SV Performed	SI Recommendation	Containments of Concern	Media
Site 1 Northeast Pond Disposal Area	Yes	Yes	RFI	Metals	Surface water sediments, soils
Site 2 Fire Training Area	Yes	Yes	RFI	VOCs, PCBs, Metals	Groundwater, soils
Site 3 Ammunition Demolition Area	No	No	-	-	-
Site 4 Picnic Grounds Disposal Area	Yes	Yes	NFI	-	-
Site 5 Gun Range Ammunition Disposal Area	No	No	-	-	-
Site 6A Fuel Calibration	Yes	Yes	RFI	VOCs	Groundwater, soils
Site 6B Engine Runup Area	Yes	Yes	NFI	-	-
Site 6C South End of Runway 32-14	Yes	Yes	NFI	-	-
Site 7 Fuel Depot Area	N/A	Yes	RFI	Hydrocarbons	Groundwater, soils
Site 8 Coal Storage Pile Area	N/A	WPS	-	-	-
Site 9 Electronic Counter Measures Area	N/A	WPS	-	-	-
Site 10 Cesspool/Leach Field Areas	N/A	WPS	-	-	-

N/A = Not applicable
 NFI = No Further Investigation
 PA = Preliminary Assessment (formerly Initial Assessment Study)
 RFA-SV = RCRA Facility Assessment Sampling Visit
 RFI = RCRA Facility Investigation
 SI = Site Inspection
 WPS = Work Plan Stage

E-12

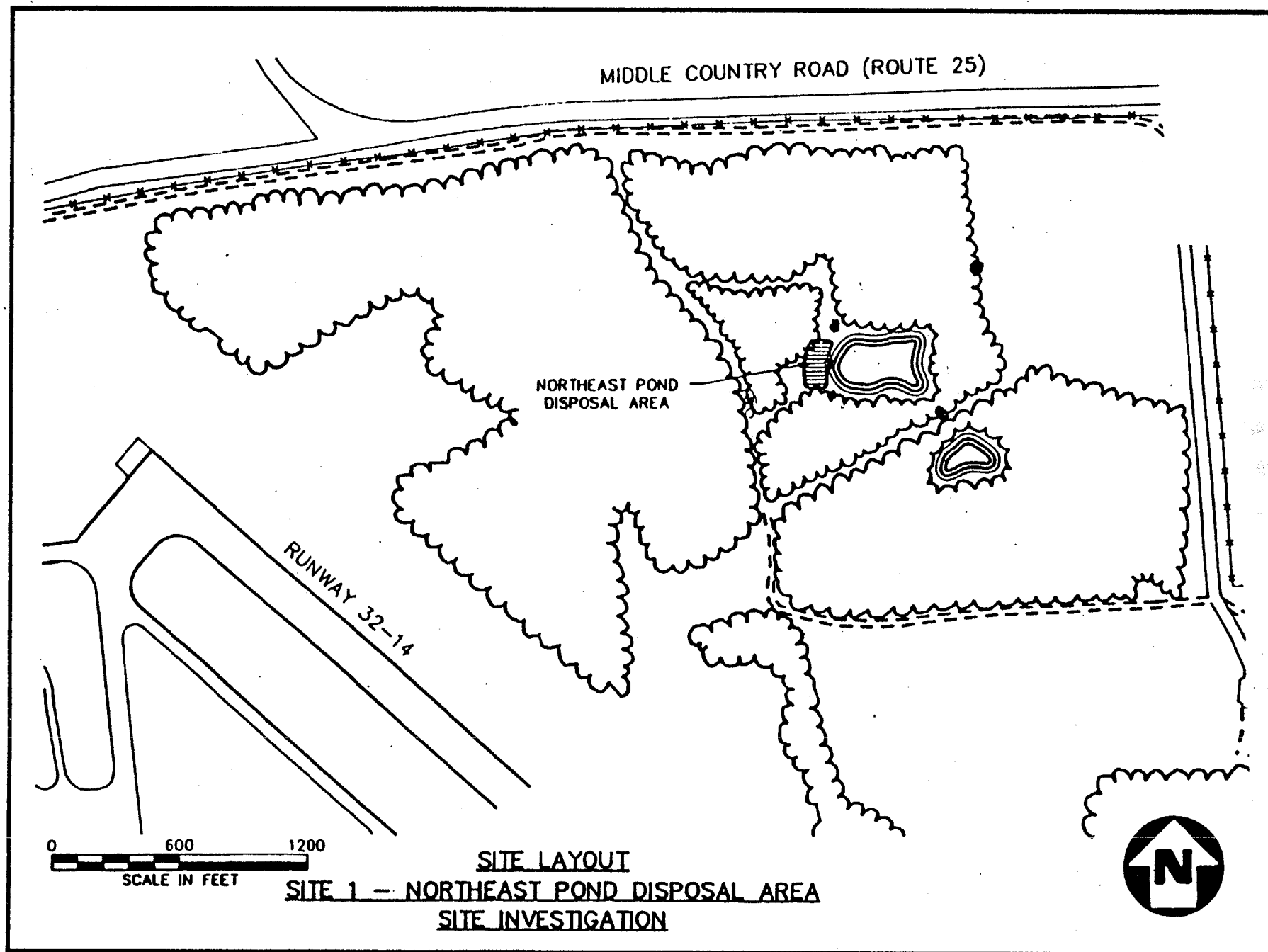


Figure 2-3

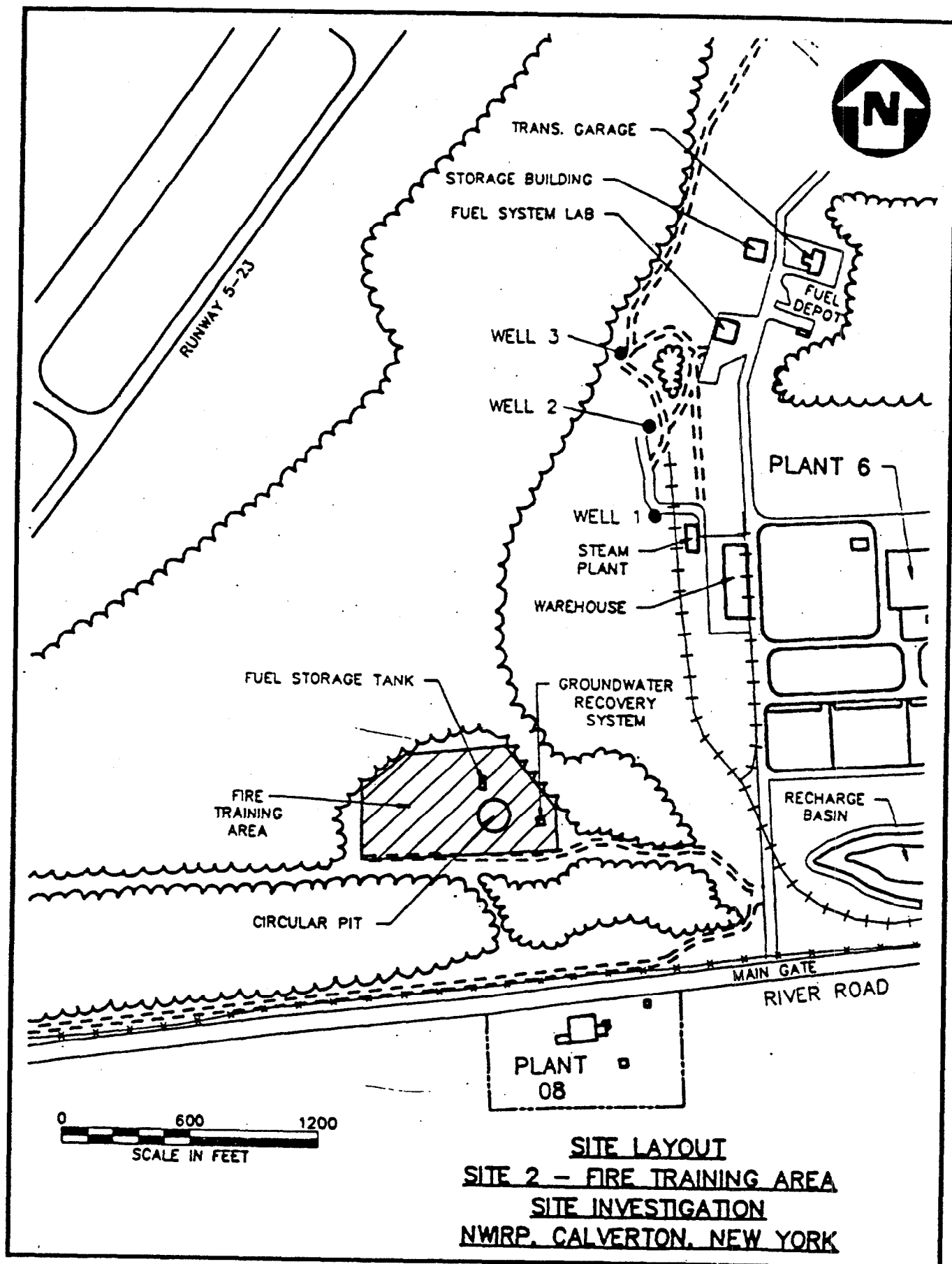
Site 2 - Fire Training Area (Figure 2-4)

The fire training area has been used by Grumman and Navy crash rescue crews as a training area since 1955, and possibly as early as 1952. Before 1985, activities at the site consisted of clearing an area up to 100 feet or more in diameter and creating an earthen berm surrounding the area. The bermed area was then filled with a layer of water. Waste fuels, oil, and periodically, waste solvents were floated on the water and ignited. The IAS reports that up to 450 gallons of waste solvent were mixed with up to 2,100 gallons of waste fuel per year for use in the training exercises. Aircraft sections were sometimes placed in the area to simulate actual crash conditions. After 1975, waste solvents were reportedly no longer mixed with the material to be ignited; only waste fuel and oil was used. Fire fighting materials used in the exercises on site included aqueous fire-fighting foam (AFFF), gaseous Halon 1301, water, and dry chemical extinguisher (RGH, 1986).

In 1982, the practice of using earthen berms was halted after the construction of a curbed, concrete pit approximately 50 feet in diameter. After the spill cleanup, a curbed, concrete, fire ring was constructed to prevent further soil contamination by waste fuels. A 1,000-gallon, above ground fuel tank was installed to replace the 6,000-gallon tank (RGH, 1986). A second spill of approximately 300 gallons of waste No.2 fuel oil occurred in 1983 originating from the 1,000-gallon fuel tank. Seven additional monitoring wells were installed. By early 1987, a total of 12 wells were located in the area. Marine Pollution Control (MPC) installed an additional 6 wells in November, 1987. In December 1987, a groundwater recovery well was installed at the fire training area.

In addition to the fire fighting area, a 6,000-gallon, underground storage tank located north of the fire training pit was used for an unknown time before 1982 to store waste fuels and solvents at the site. This tank storage area has been the location of several spills. A spill of an unknown amount of liquid (less than 6,000 gallons) originated from this tank in August 1982. MPC of Calverton, New York removed a total of 327 cubic yards of contaminated soil from the tank and spill areas in late August and early September 1982. Four groundwater monitoring wells were installed in the spill area in August 1982.

Hazardous materials expected to be associated with the fire training area include petroleum, oils and lubricants (POLs); waste solvents such as toluene, methyl ethyl ketone, and lacquer thinner; and possibly soluble lead from fuels (RGH, 1986).



Site 6a - Fuel Calibration Area (Figure 2-5)

The fuel calibration area has been active since the construction of the facility in the early 1950s. The area has moved slightly over the years; original fuel calibration area is approximately 250 feet southwest of the present area. The focus of activity in the present area shifted from the southern to the eastern edge of the concrete pad at an unknown time.

Periodic spills of jet fuels, including JP-4 and JP-5, have occurred throughout the operation, mostly due to small fuel system leaks or accidental spillage during refueling (RGH, 1986). Much of this material was spilled on the concrete surface; however, small amounts may have reached the surrounding soil. Over 230 gallons of fuel are known to have spilled in this area during the 1980s. The majority of spilled fuel and contaminated soil was reportedly cleaned up. The eastern edge of the concrete pad is currently in operation for fuel calibration activities.

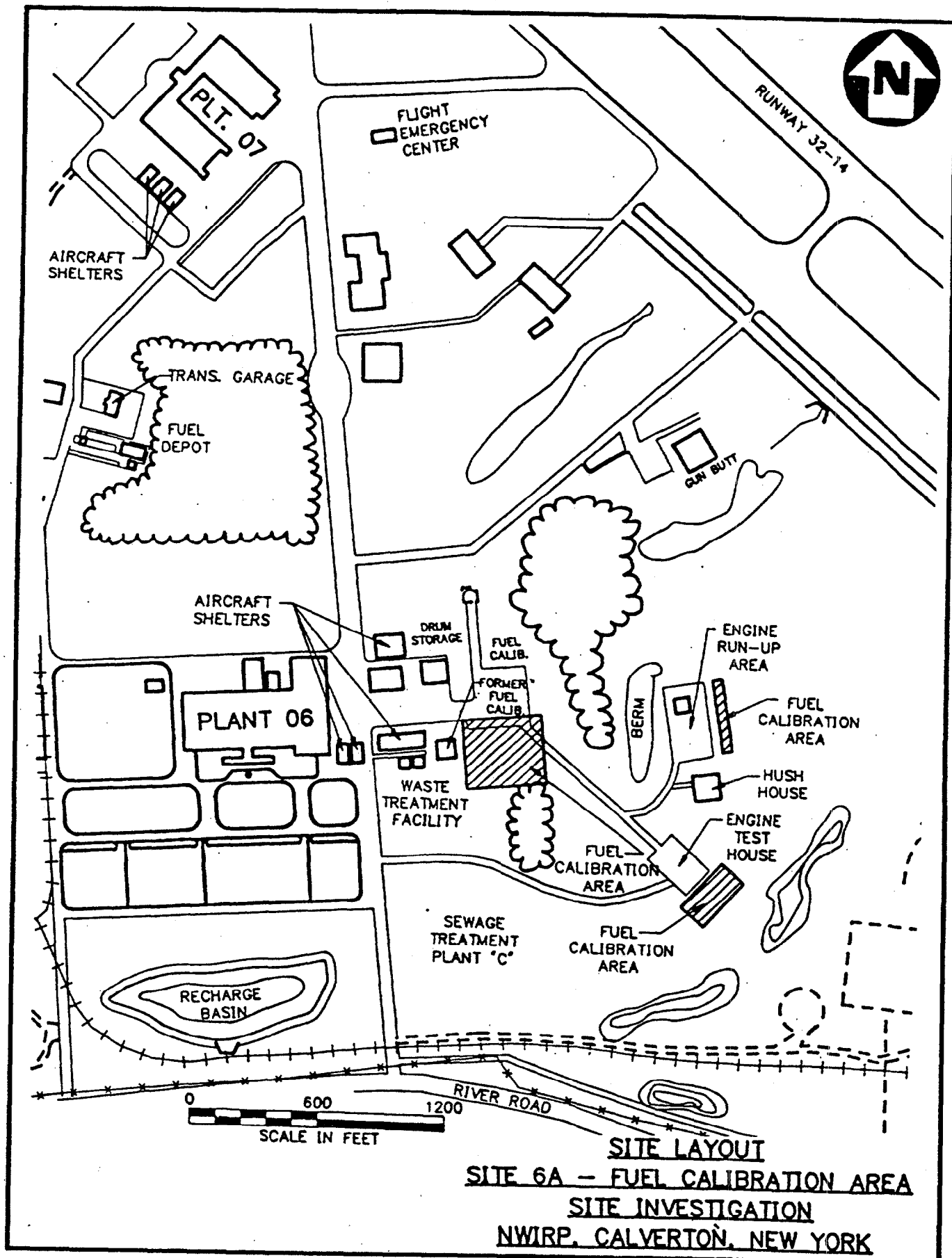
Eighteen monitoring wells were installed south and southeast of the fuel calibration pad between 1984 and 1987. A groundwater recovery unit including a pumping well and an oil recovery well oil was installed in 1987.

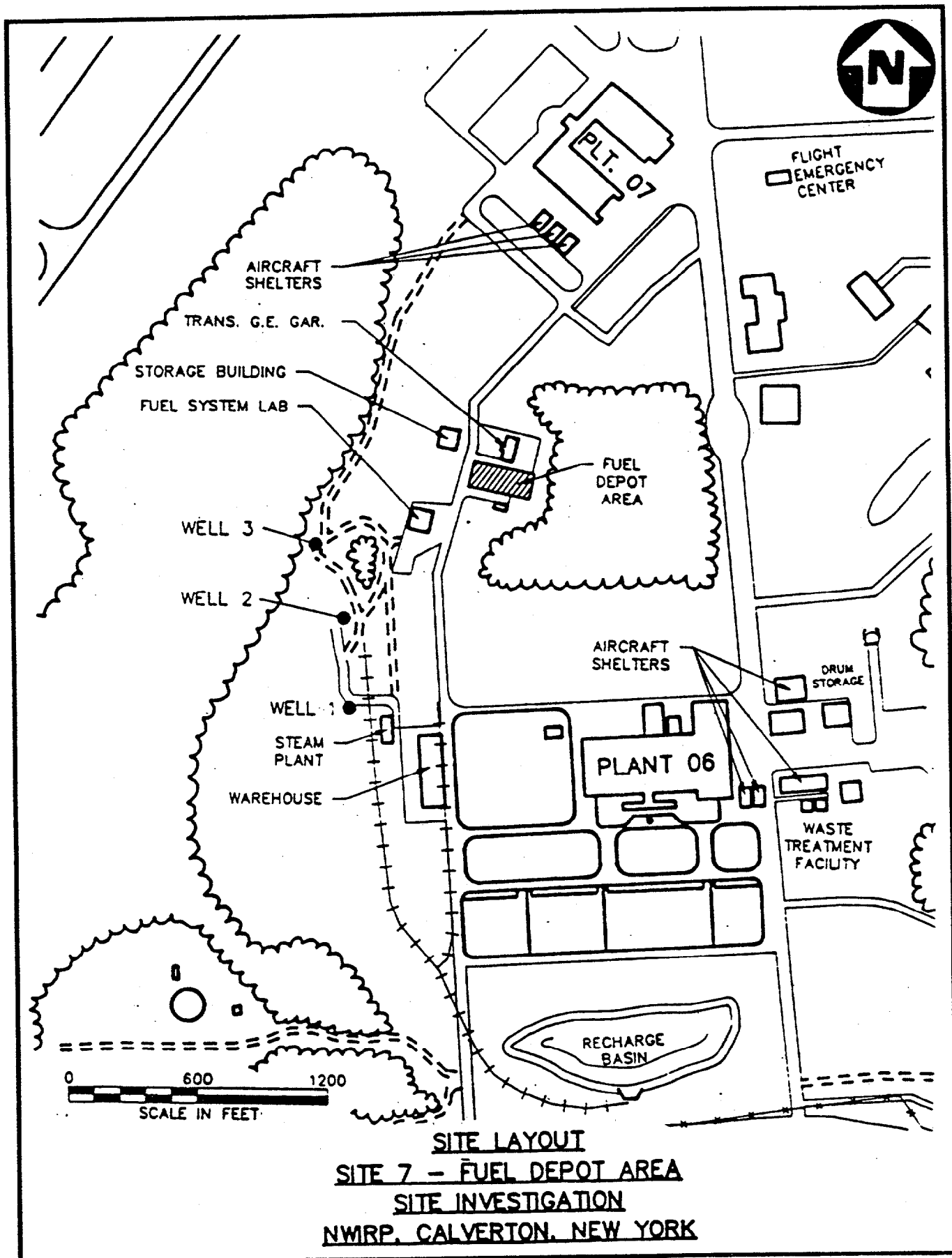
Site 7 - Fuel Depot Area (Figure 2-6)

The fuel depot area was constructed in the early 1950s and is currently active. The depot consists of two areas of underground fuel and oil storage tanks. The underground storage tank (UST) areas are primarily soil covered, with scattered concrete pads surrounding fill and vent pipes. Monitoring wells are located both within the fuel depot area and in surrounding areas. A total of 34 monitoring wells are located in the area (RGH, 1986).

2.4.2 Other Activities

Concurrent, but separate, activities are under way at other areas of NWIRP Calverton at the facility under a RCRA Facility Assessment Sampling Visit (RFA-SV). The purpose of the RFA-SV is to determine the potential for hazardous materials to be present at other areas at the NWIRP, including cesspool/leach field areas, the coal pile area, and the Electronic Counter Measures (ECM) area.





3.0 COMMUNITY RELATIONS HISTORY

3.1 U.S. NAVY

To date, no community relations activities have been initiated by the Navy at NWIRP Calverton. Any inquiries regarding the facility have been directed to the Navy's Public Affairs Office at Northern Division, Lester, PA. The Navy, currently conducting the RFI, is developing the CRP to identify information needs and plan for public involvement at key points in the investigation.

***** GRUMMAN EFFORTS TBD *****

4.0 COMMUNITY ISSUES AND CONCERNS

Issues and concerns specific to the NWIRP Calverton are expected to be identified during community interviews. It is also anticipated that new issues of importance will arise in response to the technical progress of the RFI.

At many waste management sites around the country there are common concerns. Although concerns specific to Calverton NWIRP have yet to be identified, many of the concerns frequently raised in conjunction with these sites are summarized in the following paragraphs:

Human Health Effects

The human health effects of the contamination at any site will be a very important issue for the local residents. Concern may be raised over the health impacts associated with drinking contaminated water, exposure to contaminated soil, airborne contaminants, and the relationship between cancer and hazardous waste.

Remediation Process

Citizens often raise concerns over the remediation process. Issues that can be anticipated include projected scheduling of the investigation and cleanup, the type of remediation method to be employed, and the Navy's goal for and commitment to remediation. Many residents will probably feel frustrated with the Navy for not addressing and resolving the problem when the contamination was first discovered in 1986.

Property Values

The potential decrease in property values resulting from the knowledge of the contamination associated with waste sites or the potential for a federal facility to close and to be reused. Some residents feel that these issues will result in lost equity on their homes and may prevent them from selling their houses.

Recreation

Some communities rely on income that is brought in by recreational activities such as fishing, yachting, and other water sports. Communities feel that the fear of possible contamination would divert vacationers or local residents to seek other places which are perceived as being safer.

National Priority List

The listing of a federal facility potential for NWIRP Calverton to be listed on the National Priority List (NPL) is may be an issue of concern to the community because of the perception that NPL sites are the worst hazardous waste sites in the country. Communities feel that being proposed for NPL status reflects directly on human health issues, and will hurt property values and local tourism.

Reuse Alternatives

The potential for a federal facility to close and/or to be reused is of concern to some residents. Some residents feel that the closure and/or reuse of a federal facility will effect the local economy, resale value of their homes, and employment opportunities. An example of this type of concern is reflected in the community's reaction to the proposed jetport alternative.

The CRP is intended to be responsive to the community's needs during the conduct of the investigation and community relations activities. It will be necessary to update the CRP as new views are expressed or new concerns are identified.

5.0 COMMUNITY RELATIONS OBJECTIVES AND TECHNIQUES

5.1 OBJECTIVES

The objective of all community relations efforts is to foster open communication between the public, the government, and other responsible and interested parties. The CRP will attempt to build two-way communication between the community and the Navy in an effort to:

- Inform the public regarding the progress of planned and ongoing actions at the site.
- Communicate the results of the investigation and risk assessment when available.
- Receive feedback from the public as to their specific concerns and information needs.
- Give the public the opportunity to comment on and provide input to the technical decisions associated with the site.

A format of open communication should serve to lessen and resolve conflicts, to keep the residents informed of the investigation progress, and to assist in the remediation decision-making process for the site.

5.2 TECHNIQUES

This section outlines the specific community relations techniques which will be implemented to achieve the objectives stated above.

5.2.1 Public Meetings

Public meetings, both informal and formal, are used to inform the community about ongoing site activities and findings, and to discuss and receive citizen feedback on proposed courses of action. Meetings are usually held in association with milestones in the response process, such as the release of the draft RFI report which contains the results of the remedial investigation. Public meetings will be announced in advance via press release, newspaper notices, and direct mailings to the mailing list. In addition, small informal meetings (workshops) to keep key groups and citizens informed of site activities may be held as appropriate.

5.2.2 Public Information Dissemination

Techniques used to relay information to the public will include the following:

- Information Repository - Establish and maintain an information repository, and ensure that copies of all public documents including administrative records, technical reports, and Fact Sheets pertaining to the site are readily available to interested parties.
- Mailing List - Develop a mailing list to be used in providing information to the appropriate and interested parties, including media representatives. This will be an ongoing activity.
- Responsiveness Summary - Summarize and respond to comments received during a public meeting and/or a public comment period.
- Fact Sheets - Summarize current or proposed activities of the remedial process in a brief, easily readable report. Fact sheets present technical and/or enforcement information, serve to announce public meetings, and provide background information to the public prior to a meeting.
- Contact Person - Establish a contact person who will be available to provide information, answer questions and listen to concerns from the community representatives.

5.2.3 Community Interviews

Meetings with local government officials, residents living near the site, other concerned and interested citizens, and representatives from local organizations such as the Chamber of Commerce, the Rotary Club, League of Women Voters, and other civic and environmental associations will provide information to the Navy on community needs and concerns. These interviews will provide valuable insight into the local community's level of interest and preferences for receiving status updates on site activities.

5.2.4 Technical Review Committee

A Technical Review Committee (TRC) has been established to actively participate in the development of the scope of work for the ongoing RFI, provide technical reviews and comments during the execution of the RFI and CMS,

and assist in the selection of remedial technologies based on the data gathered by the Navy's consultants. The committee includes representatives from the Navy, NYSDEC, the New York State Department of Health, the Suffolk County Department of Health, the Nature Conservancy, and Grumman Corporation. The TRC will meet quarterly, or on an as needed basis.

5.2.5 Additional Techniques if Needed

Implementation of additional community relations techniques may be necessary depending on the local community's level of concern and interest in the site. These activities reflect the dynamic nature of the CRP in response to the remedial action, and provide flexible ways to address issues that may arise. These additional techniques include:

- Periodic Bulletins - Provide status updates on technical progress and site activities on a consistent schedule.
- Technical Demonstrations - Demonstrate to the public how specific investigations (eg: well drilling) or remedial activities are being conducted.
- Advisory Committee - Develop an informal committee consisting of civic and environmental leaders for the purpose of providing direct communication between the Navy and these interested groups. This Committee would be similar to the TRC but less technical in scope.

6.0 COMMUNITY RELATIONS SCHEDULE

The schedule for future community relations activities for NWIRP Calverton will be presented in this section of the CRP. The Community Relations Milestone Chart (Figure 6-1) graphically presents anticipated community relations activities for NWIRP Calverton. Additional activities will be included in the schedule as site activities progress. It is important to note that the milestone chart and the CRP itself are dynamic and there will be a need for updating both documents to respond to changing community concerns and ongoing technical progress.

The milestone chart was developed by anticipating which community relations activities will be needed at what phase in the RCRA process, such as the completion of the RFI or when selection of corrective measures is finalized. This chart will be updated after community interviews are conducted.

FIGURE 6-1
NWIRP Calverton Community Relations Milestones

C/R Activities	Project Phases	RCRA FACILITY INVESTIGATION (RFI)			CORRECTIVE MEASURES STUDY (CMS)			CORRECTIVE MEASURES IMPLEMENTATION (CMI)		
		Work Plan	During RFI	Release of RFI Report	During CMS	Release of CMS	Selection of Measures	Beginning Design	During Design	Implementation
Public Meeting		●		●		●			●	
Fact Sheets		●	●	●		●	●		●	
Small Group/ Neighborhood Mtgs.					<i>Update as Needed</i> →					
Community Interviews			●		<i>Additional Interviews as Needed</i> →					
CRP					<i>Update as Needed</i> →					
Mailing List					<i>Develop/Update as Needed</i> →					
TRC Meetings					<i>Ongoing</i> →					
Point of Contact					<i>Ongoing</i> →					
Repository					<i>Establish/Maintain/Update</i> →					

7.0 COMMUNITY RELATIONS PLAN IMPLEMENTATION

This section discusses the roles and responsibilities of the parties involved with the community relations activities at the NWIRP Calverton site. This discussion will focus primarily on the interaction of the organizations which are currently involved.

7.1 ROLES

NWIRP Calverton is represented by two branches of the U.S. Department of Defense; the U.S. Navy and the DLA. The administration of NWIRP Calverton is carried out by the DLA because it is a GOCO facility. The environmental investigations being conducted under the Navy's IR Program are administered by Northern Division, Naval Facilities Engineering Command (NAVFAC) located in Lester, PA. The NAVFAC Remedial Project Manager and the Technical Project Manager serve as the lead Navy contacts.

The Navy, through its IR Program, is responsible for the investigations being conducted at NWIRP Calverton. The Navy is coordinating with NYSDEC and EPA Region II in order to ensure compliance with state and federal regulations. The Navy has contracted with HALLIBURTON NUS Environmental Corporation to support their field investigations.

7.2 RESPONSIBILITIES

The Navy's Remedial Project Manager and Technical Project Manager, working out of NAVFAC are responsible for the oversight and implementation of the IR Program for NWIRP Calverton.

It will necessary to identify the roles and responsibilities of the involved parties once they are defined. Some responsibilities are identified below:

NAVFAC

Run TRC

Technical oversight

Document review

Agency coordination

Procurement/Contract oversight

NYSDEC

TRC member

Lead agency oversight

HALLIBURTON NUS

Develop/implement RFI work plans
Develop RFI and CMS reports
Develop and implement CRP

GRUMMAN

TRC member

EPA Region II

TRC member

REFERENCES

Community Relations in Superfund - A Handbook. Environmental Protection Agency, (1/92).

Final Site Investigation, Naval Weapons Industrial Plant, Calverton, New York, HALLIBURTON NUS Environmental Corporation, (4/92).

Long Island Almanac - Population and governance information.

RCRA Facility Investigation, Task II Report, Pre-Investigation Evaluation of Corrective Measures Technologies, Naval Weapons Industrial Reserve Plant Calverton, NY. HALLIBURTON NUS Environmental Corporation, (10/92).

RGH (Rogers, Golden, & Halpein), Initial Assessment Study of NWIRP Bethpage, NY and NWIRP Calverton, NY. CTO N62474-84-3386, Environmental Restoration Department, Naval Energy and Environmental Support Activity, (12/86).

APPENDIX A
ACRONYMS AND ABBREVIATIONS

CMS	Corrective Measures Study
CRP	Community Relations Plan
DLA	Defense Logistics Agency
ECM	Electronic Counter Measures
EPA	Environmental Protection Agency
GOCO	Government Owned/Contractor Operated
HSWA	Hazardous and Solid Waste Amendment
IAS	Initial Assessment Study
IR	Installation Restoration
NAVFAC	Naval Facilities Engineering Command
NWIRP	Naval Weapons Industrial Reserve Plant
NYSDEC	New York State Department of Environmental Conservation
POLs	Petroleum, Oils and Lubricants
RCRA	Resource Conservation and Recovery Act
RFA-SV	RCRA Facility Assessment Sampling Visit
RFI	RCRA Field Investigations
SI	Site Investigation

APPENDIX B
LIST OF INTERESTED PARTIES

A. Federal Elected Officials

1. U.S. Senator Alfonse M. D'Amato (202) 224-6542
U.S. Senate
520 Hart Senate Office Building
Washington, DC 20510

State Office:
7 Penn Plaza (212) 947-7390
Suite 600
New York, NY 10001
2. U.S. Senator Daniel P. Moynihan (202) 224-4451
U.S. Senate
464 Russell Senate Office Building
Washington, DC 20510

State Office:
733 Third Avenue (212) 661-5150
New York, NY 10017
3. Congressman George J. Hochbrueckner (202) 224-3121
U.S. House of Representatives
Rayburn Office Building
Washington, DC 20510

State Office:
3771 Nesconset Highway,
Suite 213
Centereach, NY 11720 (516) 689-6767

B. State Elected Officials

1. Governor Mario M. Cuomo (518) 474-8390
State Capitol
Executive Chamber
Albany, NY 12224
2. Senator Kenneth P. LaValle (516) 369-0268
325 Middle Country Road
Selden, NY 11784
3. Assemblyman Joseph Sawicki (516) 727-1363
107 Roanoke Avenue
Suite 310
Riverhead, NY 11901

C. Suffolk County Officials

1. Robert J. Gaffney (516) 853-4000
Suffolk County Executive
County Center
Riverhead, NY 11901
2. Honorable Joseph F. Janoski (516) 727-3200
Supervisor of Riverhead
Town Hall
200 Howell Avenue
Riverhead, NY 11901

D. Newspapers

1. Newsday (516) 454-2700
Susan Benkelman, Environmental Writer
235 Pinelawn Road
Melville, NY 11747

E. Citizens and Other Interested Parties

This is an initial list. As the site investigation progresses it will be amended as needed to include other interested/affected citizens, public interest groups, local media, and elected officials. In addition to this list, a mailing list of concerned private citizens has been compiled. This mailing list is not included below in an effort to respect the privacy of these citizens.

1. Jesse R. Goodale III (516) 727-7600
President
Chambers of Commerce
P.O. Box 291
542 East Main Street
Riverhead, NY 11901
2. League of Women Voters (516) 271-1479
33 Parkview Terrace
Huntington, NY 11743
3. Ed Thompson (516) 795-1455
Nassau Suffolk Neighborhood Network
511 Central Avenue
Massapequa, NY 11758

F. Department of Defense Contacts

1. Robert Booth (703) 602-9472
Naval Air Systems Command Headquarters
Jefferson Plaza 2, Room 528
Washington, DC 20361
2. Debbie Felton (215) 595-0567
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway (MS #82)
Lester, PA 19113-2090

3. Jack Dunleavy
Northern Division
Naval Facilities Engineering Command
10 Industrial Highway (MS #82)
Lester, PA 19113-2090

(215) 595-0567

G. New York State Contacts

1. Joshua Epstein
Citizen Participation Specialist
NYSDEC, Region 1
Building 40
State University of New York
Stony Brook, NY 11790

(516) 751-7900

H. Technical Review Committee Members

1. Mr. A. Bellina
U.S. EPA
Air and Waste Management Division
Hazardous Waste Facilities Branch
26 Federal Plaza
New York, NY 10278
2. Mr. J. Reidy
U.S. EPA
Office of Policy and Management
Permits Administration Branch
26 Federal Plaza
New York, NY 10278
3. Mr. P. Counterman
NYSDEC
Division of Hazardous Substances Regulation
Director, Bureau of Hazardous Substances Regulation
50 Wolf Road
Albany, NY 12233-7251

4. Mr. R. Becherer
NYSDEC
Division of Hazardous Substances Regulation
Region I Headquarters
Regional Hazardous Substances Engineer
SUNY Campus, Bldg. 40
Stony Brook, NY 11790-2346
5. Mr. L. Wilson
New York State Department of Health
Two University Place, Rm. 205
Albany, NY 12203-3313
6. Mr. S. Robbins
Suffolk County Department of Health Services
225 Rabro Drive East
Hauppauge, NY 11788
7. Mr. J. Ohlmann
Grumman Corporation
Mail Stop D08-3580
Bethpage, NY 11714-3580
8. Mr. M. Simonson
Defense Plant Representative Office
Grumman Corporation
Mail Stop A23-035
Bethpage, NY 11714-3593
9. Ms. S. Antenen
The Nature Conservancy
250 Lawrence Hill Road
Cold Spring Harbor, NY 11724

I. Document Repository Location (SUGGESTED)

Riverhead Free Library

(516) 727-3228

330 Court Street

Riverhead, NY 11901

Hours of Operation

Monday - Friday

9:00 am - 9:00 pm

Saturday

9:00 am - 5:00 pm

Sunday (Oct-May)

1:00 pm - 5:00 pm

APPENDIX C
Naval Weapons Industrial Reserve Plant
Calverton, LI, NY

Potential Interview Questions

Date and Time:

Interviewee:

GENERAL AWARENESS

- 1) How would you gauge the general level of community awareness of the NWIRP Calverton site?
- 2) How do you perceive past and current efforts in providing the community with information about the site?

LEVEL OF CONCERN

- 1) What are your primary concerns regarding the site?
- 2) Do you feel that you are affected by the potential contamination at the site? If so, how?
- 3) What kinds of issues about the site and potential contamination have attracted the most attention?

INFORMATION NEEDS

- 1) How do you get information about the site and how frequently do you get it?
- 2) How would you like to get information about the site? How frequently?
- 3) If you had a question or an issue to raise, who would you contact?
- 4) Are you aware of the information repository that has been established in your area? Have you ever used it?
- 5) What newspapers, radio, or T.V. stations do you use?

LEVEL OF INVOLVEMENT

- 1) Have you participated in activities concerning the site?
- 2) What opportunities for input or involvement should be provided? What techniques work best in this community and would meet your needs?
- 4) Would you like your name and address added to a mailing list? (verify spelling/ address)

REFERRALS

- 1) Do you have any suggestions of other groups or individuals who should be added to the mailing list?